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Medieval Mensuration: *Quadrans Vetus* and *Geometrie Due Sunt Partes Principales . . .*

NAN L. HAHN

Department of History, Rutgers University

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THE AMERICAN PHILOSOPHICAL SOCIETY

Independence Square, Philadelphia

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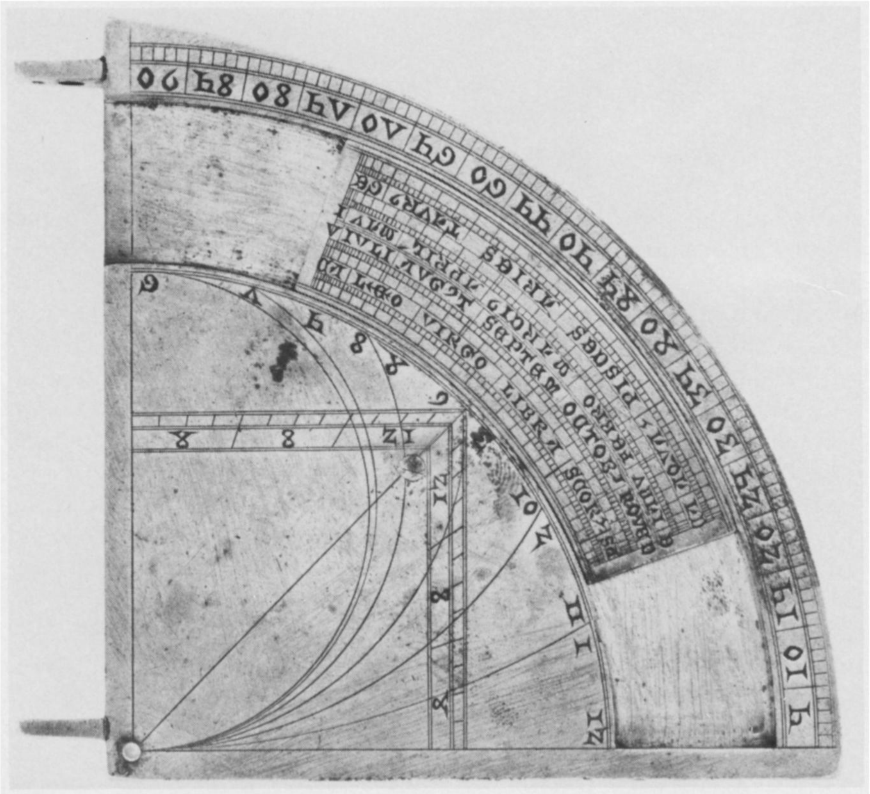

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ABBREVIATIONS USED IN THE EDITIONS OF THE TEXTS

]	reads
( )	when adjacent to word, an alternate reading; when following a space, an addition in the indicated manuscript(s)
a.	anno
add	added
c	century
ca.	circa
del	deleted
f., ff.	folio, folios
mg	margin, marginal note
om	omit, omitted
r	recto
v	verso
r^{a}, v^{a}	recto, verso: first column
r^{b}, v^{b}	recto, verso: second column
rell	relliquus
tit	title
(?)	missing word

PREFACE

This volume is an outgrowth of my doctoral dissertation, which was written for Emory University under the direction of the late Francis S. Benjamin, Jr. The idea for a critical edition of *Quadrans vetus* arose from Dr. Benjamin's knowledge of its frequent appearance in late-medieval astronomical manuscripts. A search through his vast personal collection of manuscript descriptions revealed almost one hundred citations of extant copies; subsequent additions to this list from my researches and those of Stephen K. Victor brought the total number to one hundred four. It was obvious from the broad distribution of these copies and the sheer numbers surviving that the treatise received wide usage in the late Middle Ages and deserved a new, critical edition. Further research brought to light the connection between *Quadrans vetus* and an older work, *Geometrie due sunt partes principales*. As the latter had not been published, it was felt appropriate to include a critical edition of it. Another relevant but unpublished treatise emerged; a work in an Oxford University manuscript proved to be another version of *Quadrans vetus*, and an edition of it appears in Appendix B.

The imprint of Francis Benjamin on this work is far too great to be adequately expressed here. A fountain of knowledge and wisdom and an indefatigable and exacting scholar, he served as a model to his students and set standards that we still strive, often vainly, to meet. His contributions as a scholar and a friend were immeasurable, and whatever shortcomings are in this volume would no doubt have been lessened if he had lived to comb through the manuscript yet once again, in its latest version.

I have had generous and excellent help and criticism from numerous scholars and friends in more recent stages of this work. I especially wish to thank Wesley M. Stevens and Stephen K. Victor for their critical appraisals and suggestions. My husband, Andrew L. Hahn, read and criticized innumerable versions of the introduction, clarified some mathematical problems for me, and served alternately as coaxer and prodder. His relief at the end of this task is equal to my own.

I also wish to thank my friend David M. Sutherland for his contribution of the diagram of the *quandrans vetus* and the drawings that accompany the introduction. I must also thank Anna M. Mahowski and Dinah N. McAllister for their untiring efforts in typing and proofreading. I extend my appreciation to Princeton University Library for permission to use the photographs included from Robert Garrett manuscript 99. I am also grateful to the Instituto e Museo di Storia della Scienza of Florence and its former director, the late Professor Maria Luisa Righini Bonelli, for assistance in my researches and permission to use the photograph of the *quadrans vetus* in that collection, and I am indebted to all of the libraries and institutions listed on the pages under "Manuscript Sigla" for providing access to the manuscripts or photographic copies of them and for granting permission to use the materials.

INTRODUCTION

The *Tractatus quadrantis,* or more frequently the *Quadrans vetus,* is a thirteenth-century treatise describing the construction and use of the "old quadrant," an instrument of Arabic origin which found its way into the Latin West by sometime in the twelfth century.[1] The more common title, *Quadrans vetus,* came into use after the *Quadrans novus* of Jacob ben Machir, circa 1288, became known. Because of the frequent use of *Quadrans vetus* in surviving manuscripts and its more precise name, I shall use that title to refer to the treatise throughout this work. To avoid confusion between the treatise and the actual instrument, I shall often use the English form, old quadrant, to refer to the instrument itself.

The tract, one of several documents describing newly introduced Arabic instruments, was written in Montpellier, probably between 1250 and 1280. The authorship and exact dating will be discussed later in this introduction. The author of the treatise does not claim to have invented the instrument but rather is concerned with presenting detailed instructions for its construction and operation. According to him, the uses of the instrument include the measure of altitudes of the sun and stars, heights of buildings and mountains, depths of pits, and the latitude of any given region. The instrument also includes hour lines that enable the user to determine the unequal hours of the day, making it even more valuable as a portable sundial.[2] After giving procedures for such measurements by this instrument, the author includes directions for solving many of the same problems without the quadrant, by use of mirrors, rods, and shadows. With all of those possibilities, the work as a whole could form a practical handbook for the surveyor, builder, navigator and traveler. It would also be a useful text in teaching the *quadrivium* in schools and universities.

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[1] The history of the development of the quadrant is treated by Emmanuel Poulle in "Les instruments astronomiques de l'Occident latin aux XI^e et XII^e siècles," *Cahiers de civilisation médiévale,* 15 (1972): 27–40; by J. Millás Vallicrosa, "La introducción del cuadrante con cursor en Europa," *Isis,* 17 (1932): 218–258, reprinted in *Estudios sobre historia de la cientia espanola* (Barcelona, 1949), pp. 65–110, 6 pl., and by Peter Schmalzl in *Zur Geschichte des Quadranten bei den Arabern* (München: Druck der Salesianischen Offizin, 1929). This is also discussed by Paul Tannery in his edition of this treatise, "Le Traité du quadrant de maitre Robert Anglès (Montpellier, XIII^e siècle). Texte latin et traduction grecque," *Memoires scientifiques* (9 vols., Toulouse, 1912–1922), 5: p. 122, and by G. Boffito and C. Melzi D'Eril, *Il Quadrante D'Israele di Jacob ben Machir ben Tibbon* (*Profacio*) (Firenze, 1922), pp. 7–11.

[2] "Unequal hours" are those hours whose value vary according to the season of the year. The total amount of daylight on a given day is divided into twelve equal portions; the same is done for the hours of darkness. The term "natural hours" appears in some treatises in our study; it denotes unequal hours. The phrases "natural hours" and "unequal hours" are in contrast to the twenty-four "equal hours" which began to appear in use in towns with mechanical clocks in the thirteenth century. The two types of time measurement coexisted through the late Middle Ages.

The manuscripts used in this study date from the late thirteenth century to 1600, a closing date chosen because of the decline of manuscript production in Europe. Within these dates I have found over one hundred Latin copies and numerous references to translations into other languages. I have confined my work to the Latin manuscripts. The abundance of these is indicative of the breadth of distribution of the treatise and of its importance during the later Middle Ages.

Aside from the many Latin copies of *Quadrans vetus,* there are early translations into German, Hebrew, and even Greek within two centuries of its composition.[3] The only modern printed edition of the work, that of Paul Tannery in 1897, was a result of his efforts to determine the origin of a Greek translation of the Bibliothèque Nationale, Paris.[4] In discussing his edition, Tannery stated that numerous translations of theological and literary works from Latin into Greek were produced from about 1300 to the sixteenth century, but he found only one other manuscript of a technical nature which was so translated during this period. The one other example is a work attributed to Albertus Magnus and translated by Georges Midiates in 1460.[5]

In 1508 the first printed edition of *Quadrans vetus* appeared in a pirated edition of the *Margarita Philosophica,* a popular encyclopedia first published by Gregory Reisch in 1503 and based on the seven liberal arts. Johannes Grüninger of Strasbourg published the unauthorized edition and included our work as an appendix to *Liber VI: De elementis geometrie,* entitled "Introductio Architecturae et Perspectivae."[6] The appendix is attributed to Martin Waltzemüller (called Hylacomylus), but it is, in fact, the entire text of *Quadrans vetus*, with a few changes in the introduction and an addition of another shorter work.[7] This last portion is very similar in both text and drawings to a treatise on perspective by Jean Pélerin, alias Johannes Viator, canon of Toul.[8]

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[3] Moritz Steinschneider, *Die Hebräischen Übersetzungen des Mittelalters und die Juden als Dolmetscher* (Graz; 1956), p. 607.

[4] Tannery, "Traité du quadrant," pp. 118–119.

[5] Ibid., p. 122. This translation is found in Bibliothèque Nationale, fonds grec 2419, and was originally cited by M. Berthelot, *Collection des anciens alchimistes grecs* (Paris, 1887), pp. ix ff. I have not seen the manuscript, but Berthelot describes it as containing astrological, magic and alchemical treatises. He maintains that the Greek version is a direct translation from a Latin treatise, demonstrating this in a line-by-line comparison with a copy of the Latin text (pp. 208–209). He cites two printed editions of the Latin text. One appears at the end of Albertus's works in *Theatrum Chemicum,* 2, and the other in the collected works of Albertus. In neither case does he give complete citations for his printed sources. The explicit of the Greek copy which he quotes includes as its author the name Ampertos Theoctonicos, which Berthelot holds to be a corruption of Albertus Teutonicus, whom he identifies as Albertus Magnus (p. 208).

[6] *Margarita Philosophica* (Strasbourg: Johannes Grüninger, 1508), f. 162. A note on the various editions is in order. The card catalog of the British Library in 1967 included descriptions of sixteen copies of the *Margarita Philosophica* in Latin. The following is based on the information in the catalog and my examination of the described copies at the Library. Among the sixteen copies listed, there are eleven separate editions, ranging chronologically from the 1503 edition published by Johannus Schottus in Fribarg to a 1583 reprint of the 1535 edition in Basel by Sebastian Henricus Petrus. There is a 1504 printing by Schottus, identical to his 1503 publication, and a 1504 edition by Johannes Grüninger of Strasbourg with the added caption, *Cum additionibus: Que in aliis habentur.* Schottus, in turn, published a 1508 revised edition at Basel. None of these contain the appendix of *Quadrans vetus* or Pélerin's treatise

With this widespread distribution, questions arise about the use of the treatise. One would assume from its very practical approach that its most common use would have been by ship captains, surveyors and others who needed the technical aid for their occupations. Yet E. G. R. Taylor maintains that the earliest record of sailors taking an instrumental observation of the skies is from 1456–1457; this was with the "seaman's quadrant," a predecessor of the old quadrant which Tannery calls the "simple quadrant." It consisted of a quarter of a circle with a scale of ninety degrees engraved on the arc, two sighting tables on one side of the angle, and a plumbline, and could be used for marking the angle of elevation of the sighting when a star was observed.[9] Sailors, surveyors, and many land travelers in the fifteenth century were still generally prevented from using the more sophisticated features of the old quadrant because of their lack of mathematical training. Most of the drawings in manuscript copies of *Quadrans vetus* illustrate uses in measurements of heights and horizontal distances that require some understanding of the mathematical functions involved. Some of the more cumbersome marginal notes are attempts by the scribes to explain concepts that apparently were not easily grasped by themselves or their readers. Extensive use of the treatise in the non-academic world would have to be demonstrated by other evidence, such as the survival of examples of the instrument in sufficient numbers to indicate this.

I have located only four extant old quadrants. One, a Gothic model at the Museum of the History of Science in Florence, is dated between 1200 and 1300. Professor M. L. R. Bonelli dated this instrument by the equinox

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on perspective. Grüninger's 1508 edition at Strasbourg is the earliest in the British Library collection which includes both of these items. He also includes the appendix in his 1512 and 1517 editions. However, only one other edition in the collection contains these additions: a 1535 publication by Henricus Petrus in Basel and its reprinting in the same city 1583. This rendition of *Quadrans vetus* is very much altered in the order of the text. It is followed by an edition of Messahala's treatise on the astrolabe.

[7] The edition is discussed, with quotations from Waltzemüller's correspondence claiming the works as his own, in Avezac, *Martin Hylacomylus Waltzemüller, ses ouvrages et ses collaborateurs* (Paris, 1867), p. 109.

[8] A comparison of the first edition of Pélerin's treatise (Toul, 1505) with the work in the 1508 edition of the *Margarita Philosophica* shows the latter work clearly to be pirated from the former. See William M. Ivins, Jr., *On the Rationalization of Sight, With an Examination of Three Renaissance texts on Perspective,* published with Viator, *De Artificiali Perspectiva, Reproducing Both the First Edition (Toul, 1505) and the Second Edition (Toul, 1509)* (New York, 1973, following p. 44. See also Erwin Panofsky, *Renaissance and Renascences in Western Art* (New York, 1969), p. 123, n. 2, for a discussion of Pélerin's work.

[9] E. G. R. Taylor, *The Haven-Finding Art* (London, 1956), p. 159. This was recorded by Diogo Gomes, sailing to Guinea in the service of Prince Henry of Portugal. Tannery, "Traité du quadrant," p. 122.

which is indicated as falling on March 31.[10] The second is a model inscribed with the date 1479 and is in the Museum of the History of Science of Oxford.[11] The third was purchased by the British Museum in 1971. Dr. F. A. B. Ward considers this instrument to be English, dating from the fourteenth century. The fourth quadrant is dated circa 1600, probably Italian, and is a part of the collection of the Whipple Museum in Cambridge.[12] A search of the literature and consultations with curators have produced no evidence of other extant copies. This, of course, does not preclude widespread distribution of the instrument; any article made of brass, the preferred material, is likely to have been melted down later for other uses, and wooden examples would hardly have survived long-term outdoor employment. In addition, the cursor, a sliding curved table in the arc, could be moved past the edge and broken or lost, seriously impairing the usefulness of the instrument. Yet the old quadrant is hardly alone among late-medieval instruments in its rarity today. Of the more than three thousand items in the antique instrument collection of the Adler Planetarium in Chicago, fewer than twenty were produced prior to 1600.[13]

Emmanuel Poulle has suggested that there probably were very few old quadrants made because two of the instrument's most useful features, the shadow square and the hour lines, were soon inscribed on the back of the astrolabe. This allowed that instrument to serve all of its own usual purposes, such as star maps for astronomy and navigation problems, plus those of the old quadrant.[14] This is a possibility, but the old quadrant could be constructed far more easily and cheaply than an astrolabe, and it seems unlikely that the more expensive instrument would have taken precedence over the lesser in common usage. Also, E. G. R. Taylor argues convincingly that the astrolabe was beyond the comprehension of any non-mathematician in the fifteenth century.[15]

The same arguments could be applied to the *quadrans novus*, or "new quadrant," described by Jacob ben Machir ibn Tibbon in 1288. This instrument apparently proved very popular, and one would think that it might have replaced the earlier quadrant. (Its invention led to the earlier instrument becoming known as the *quadrans vetus*, or "old quadrant.") It apparently evolved in a manner similar to that of the old quadrant. In the latter case, the instrument seems to have resulted from someone combining the simple quadrant with the cursor and the shadow square, an Arabic device known before A.D. 1000. It is a square with a plumbline affixed to one angle, with the two sides opposite this angle marked off in a series of twelve points each, for measuring tangents and cotangents.[16] The cursor is a movable plate in the arc of the quadrant; it contains a zodiac calendar and a Roman calendar in corresponding juxtaposition. The resulting old quadrant was far more useful than any of its three separate components. Jacob ben Machir, or the inventor whose work he described, also created a new instrument out of known components, by combining the advantages of the astrolabe with the portability and facility of the old quadrant. For example, the old quadrant required bissextal tables to find the position of the sun in its ecliptic; he eliminated this need by adding the double calendar scale of the dorsal side of the astrolabe to the new instrument. (This scale shows the relationship of the ecliptic, marked in zodiacal signs, to the Roman calendar in months and days.)[17] As a result, Jacob's invention is frequently referred to in museum collections and appropriate literature as the astrolabe-quadrant. Consequently, a comparison of the texts of *Quadrans vetus* and the work of Jacob shows a strong similarity in portions of the usage sections that describe the features shared by the old and new quadrants. Differences in the texts on usage emerge when Jacob discusses the features adopted from the astrolabe.[18]

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[10] Maria Luisa Righini Bonelli, *Il Museo di storia della scienza a Firenze* (Firenze, 1968), p. 169, item 131 and plate 43. A picture of the dorsal side of this instrument appears as figure 1.

[11] I was permitted to study this instrument at the museum under the guidance of the curator, Mr. Francis Maddison, in 1967.

[12] The source of the information on the third item is a personal communication from Mr. B. Hutchison, Research Assistant, British Museum, dated 2 August 1976. Dr. Ward's forthcoming *Catalogue of Scientific Instruments* will include a discussion of this instrument. My source on the quadrant in Cambridge is a personal communication from R. S. and M. K. Webster, co-curators of Antique Instruments, The Adler Planetarium, Chicago, dated 26 November 1974.

[13] I was permitted to study the early pieces of this collection at the Adler Planetarium under the guidance of Mr. Roderick S. Webster, co-curator of Antique Instruments, in November 1970. For a discussion of instruments in this collection and other early instruments, see R. S. and M. K. Webster, *Index of Western Instrument Makers to 1850* (Winnetka, Illinois, 1968—); volumes 1 and 2, covering A-B and C-F respectively, are now in print.

[14] Emmanuel Poulle, "Les instruments astronomiques du Moyen Age," *Le Ruban Rouge*, February, 1967: 18, and Poulle, "Les instruments astronomiques de l'Occident latin . . .," p. 39.

[15] Taylor, *Art*, p. 158.

The result of Jacob's combination is an instrument that has more uses than the old quadrant but is also more difficult to construct and requires a more extensive knowledge of astronomy and mathematics. Therefore the old quadrant remains the intermediate instrument between the simple or seaman's quadrant and the astrolabe. Since trigonometric functions were apparently difficult for many of the scribes of *Quadrans vetus* or their readers to understand, the treatise on the new quadrant would be confined to an even smaller reading public. It is not a question of one instrument or one treatise superseding the other. The two served different groups of people according to their particular needs and abilities. In addition, the directions for construction of the old quadrant in *Quadrans vetus* are much more explicit and easier to follow than those given for the new quadrant in the Boffito edition of *Quadrans novus*. Therefore I suggest that the limited number of extant old quadrants is not a proper criterion for evaluating the extent of the instrument's use in the late Middle Ages. Its distribution can only be guessed at this time.

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[16] Tannery, "Traité du quadrante," p. 122.

[17] Boffito and Melzi D'Eril, *Il Quadrante*, pp. 18–19.

[18] There is much similarity between the first seven chapters of Jacob ben Machir, in Boffito and Melzi D'Eril, *Il Quadrante*, pp. 25–29, and the early paragraphs of the usage section of *Quadrans vetus*, paragraphs 32–45. Differences are apparent in chapters 12–17 of Jacob's work, pp. 33–37.

The importance of *Quadrans vetus* during the late Middle Ages has been demonstrated by the large number of extant manuscripts. Similarly the importance of *Quadrans novus* continued during the same period. Boffito and Melzi d'Eril had located thirty-seven extant copies by the time of the publication of their edition of 1922.[19] The continuing influence of the latter document is certainly demonstrated by its use in the early fifteenth century by John of Gmunden. His three treatises on the quadrant, written between 1424 and 1439, are derivations of the work of Jacob ben Machir, with an updating of the calendars.[20]

The popularity of *Quadrans vetus* can be accounted for in a way other than practical application. It seems quite possible that the document was employed as a mathematical textbook in the schools of the time. The treatise is a product of Montpellier, a university center. I have seen no internal evidence in the manuscripts of this study that indicates that their origins were university centers, but the mathematical material discussed in the treatise would be appropriate for the curriculum of any school or university. There are records of the use of a certain *Tractatus quadrantis* in the curriculum at Bologna in the early fifteenth century. The treatise is in the program of lectures in astrology and occurs in the third year, along with Alcabitius, probably his *Isagoge* (introduction to judicial astronomy), Ptolemy, *Centiloquium*, with commentary by Haly, and Euclid, *Liber III*.[21] In citing this same curriculum statute, Rashdall points out that astrology was interpreted to include mathematics. As he notes, there was at Bologna "a chair of arithmetic whose occupant was required 'Omnem mensuram terre et muri et generaliter cuiuslibet laborarii communis Bononie mensurare et agrimensare, et etiam omnes rationes communis Bononie male visas et chalculatas revidere et reffermare.'"[22] The sources do not indicate which *Tractatus quadrantis* was used in Bologna, but three manuscripts still in the University Library contain this particular treatise.[23] Considering this evidence of availability and the extensive material on measurements in the treatise, it is at least feasible that this was the document used. If not, it certainly found widespread use elsewhere, to have survived in so many Latin manuscripts with such a broad distribution and at least one early printed edition.[24]

The above information on the treatise certainly justifies a critical edition of the document. In addition, I have been able to identify very probable sources for most of the contents. As one of the principal sources, *Geometrie due sunt partes principales,* has not been edited previously, I have included an edition of it in this volume. The edition of *Quadrans vetus* is based on sixty-five of the extant manuscripts. This group includes all of the available thirteenth-century copies and a broad selection from the later manuscripts of the treatise. Fourteen copies of *Geometrie due sunt partes principales* have been used for that edition. There are also analyses of the contents of both documents, and I have included a study of the presumed sources of *Quadrans vetus* and their relationship to that treatise. In this discussion I have described the instruments presented in the earlier documents and provided a cursory view of the state of development of such instruments prior to the writing of the *Quadrans vetus.* A section on the procedures of collating the texts and on conclusions reached about relationships among the manuscripts follows. A brief discussion of another possible version of *Quadrans vetus* concludes the commentary on the text.

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[19] Ibid., p. 11.

[20] John Mundy, "John of Gmunden," *Isis*, 34 (1943): 200 and notes 48–51.

[21] Lynn Thorndike, *University Records and Life in the Middle Ages* (New York, 1944), p. 281.

[22] Hastings Rashdall, *The Universities of Europe*, ed. F. M. Powicke and A. B. Emden (3 vols., Oxford, 1936), 1: 248, note 3.

[23] Bologna, University Library, ms. 132(154), 14c, ff. 120r–125r; ms. 957(1845), 14c, Item 4; ms. 2284, n.d., ff. 72r^{b}–73r^{b}.

[24] Cf. discussion of its inclusion in *Margarita Philosophica*, note 6 above.

A. Authorship of *Quadrans vetus*

The authorship of the treatise is a complicated problem. Several names appear in catalogs listing the manuscript, and at least two names, Robertus Anglicus (sometimes of Montpellier) and Johannes (sometimes Anglicus) of Montpellier appear occasionally in the manuscripts themselves. Recent scholarship on this matter begins with the articles and the edition of Paul Tannery in the late nineteenth century. Tannery discusses the possibility of each of the two principal contenders and defends Robertus as the author. He offers several arguments for this choice in the introduction to his edition of the treatise and attempts to prove that the author of this treatise is the same Robertus Anglicus who wrote the *Commentary* on Sacrobosco's *Sphera.* He maintains that Robertus taught at Montpellier during the time of the supposed writing of the treatise, circa 1270. However, in the manuscripts listed by Tannery in his study, the following attributions occur:[25]

Johannes in/of Montpellier—7
Johannes Anglicus in Montpellier—3
Johannes Anglicus—2

Robertus Anglicus—2
Robertus Anglicus (Kilwardby)—1
Robert of Lincoln (Grosseteste)—1

Arnold of Villanova—1
anonymous or doubtful—18

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[25] Tannery, "Traité du quadrante," pp. 127–132.

With this distribution Tannery must offer other arguments to prove the authorship of Robertus. He maintains as a major point that the abbreviation "Jo," which appears in some manuscripts, was a misreading by scribes of "Ro," for Robertus.[26] This in itself is a weak argument, especially when he insists that this confusion arose because Johannes was a more common name than Robertus during the late Middle Ages. In his list of available manuscripts Tannery includes no copy using either abbreviation.[27] The argument against the common usage of Robertus is strictly subjective and is impossible to defend, given the rather long list of men by this name who are cited in both Sarton and Thorndike as being among the scientists of the period.[28] Concerning the abbreviation argument, in the preparation of this edition I have rarely seen a name abbreviation which was too short or unclear to be understood. In one or two cases I have observed a "Joh" which perhaps might be confused with "Rob." Yet the distinct "I/J," even when embellished, could hardly be confused with the traditional "R" with its long tail and curl at the top.

The second scholar concerned with the authorship problem is Lynn Thorndike, who wrote two articles on this subject. The first, entitled "Robertus Anglicus," was written in 1943 and follows Tannery's argument, identifying the author of the treatise as the Robertus Anglicus who wrote the *Commentary* on Sacrobosco's *Sphera*.[29] Thorndike later re-examined his position and wrote "Who Wrote *Quadrans vetus*?" in 1947.[30] In this article he rejected Tannery's arguments, maintaining that the hypothesis of the mistaken abbreviation was too weak to account for two traditions of authorship. He surveyed the names appearing in the manuscripts Tannery had seen, in others used by Boffito and Melzi d'Eril in their study of *Quadrans novus*, and in some of his own discovery and tabulated the following results:[31]

anonymous—24 or 25

John in/of Montpellier—8 or 9
Johannes Anglicus in/of Montpellier—6

Robertus Anglicus in/of Montpellier—1

Along with this statistical evidence, Thorndike cites the position of the Bibliothèque Nationale, Paris, in its eighteenth-century catalog and of the

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[26] Ibid., p. 131.

[27] Ibid., pp. 127–132.

[28] Lynn Thorndike and Pearl Kibre, *A Catalogue of Incipits of Mediaeval Scientific Writings in Latin*, revised edition (Cambridge, Mass., 1963), cols. 1832–1847 and 1903–1904; George Sarton, *Introduction to the History of Science* (3 vols., Baltimore, 1927–1948), 2, 2: 1189–1191 and 1223–1224; and Lynn Thorndike, *A History of Magic and Experimental Science* (8 v., New York, 1923–1958), 2: 1018 and 1023.

[29] Lynn Thorndike, "Robertus Anglicus," *Isis*, 34 (1943): 467–469.

[30] Lynn Thorndike, "Who Wrote *Quadrans vetus*?" *Isis*, 37 (1947): 150–153.

[31] Ibid., p. 152.

British Library in its twentieth-century studies, both of which attribute the authorship to John of Montpellier.[32]

Thorndike's third argument in refutation of Tannery centers on the identification of the author of *Quadrans vetus* as the Robertus Anglicus who wrote the *Commentary* on Sacrobosco's *Sphera.* He suggests that if the authorship of the two is identical, the manuscripts containing either would probably contain both, and he cites several manuscripts in which this is not the case.[33] My own survey of eighty manuscripts containing *Quadrans vetus* supports his findings; fifteen of these include a copy of Sacrobosco's *Sphera* and none have the *Commentary* attributed to Robertus Anglicus. Yet the value of the argument concerning the *Commentary* is minor, as one cannot be certain that the manuscripts today contain their exact original contents.

Thorndike points out one additional item of evidence which at least should be mentioned. Although the *Commentary* is occasionally ascribed to another Robert (sometimes Grosseteste, sometimes Kilwardby), he has never seen it attributed to a John.[34] This indicates even less chance that the same author wrote both the *Commentary* and *Quadrans vetus.*

With these arguments against Tannery, Thorndike draws a tentative conclusion that the author is Johannes of Montpellier.[35] Yet later, in his 1963 revised edition of the *Catalogue,* he is unsure enough to include three possibilities: Johannes Anglicus, Johannes of Montpellier, and Robertus Anglicus. He makes no value judgment in this, his last published comment on the subject before his death in 1965.[36]

Both J. M. Millás Vallicrosa and Emmanuel Poulle have discussed the treatise and its authorship. Millás Vallicrosa accepts Tannery's attachment of the work to Robertus Anglicus, but he argues that a number of treatises of the tenth and eleventh centuries would be incomprehensible if knowledge of at least some of the principles of the old quadrant had not been available in Europe prior to the thirteenth century. Yet he does not suggest that our treatise was composed before 1200 but rather maintains that the author of *Quadrans vetus* compiled a treatise about an instrument that was relatively well-known in Europe by the first quarter of the thirteenth century.[37] Poulle agrees with Millás Vallicrosa's view of the existence of earlier material on the subject and adds his own view that *Quadrans vetus* must have been written in the twelfth century. His argument is that two of the essential components of the old quadrant (as opposed to other quadrants) are the shadow square and the unequal hour lines and that these were known to Raymond of Marseilles prior to 1141. These, he says, were borrowed from the old quadrant by astrolabists for use on their instrument sometime during the twelfth century. In addition, he maintains that the twelfth century is the classical period for the development of a number of astronomical instruments of the Middle Ages. According to his view, modifications which occurred during the succeeding centuries were relatively minor. Poulle's argument that the development of the instrument was a twelfth-century phenomenon is certainly reasonable. However, it does not necessarily follow that the treatise under study was the product of a twelfth-century scholar.[38]

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[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Ibid., p. 153.

[36] Thorndike and Kibre, *Catalogue of Incipits,* col. 585.

[37] Millás Vallicrosa, "Introduccion del cuadrante," p. 251.

In my own survey of available manuscripts and descriptions of others that I have not seen, I have found the following distribution of authorship:

uncertain—6
anonymous—50

Johannes Anglicus—1
Johannes in Montpellier—13
Johannes Anglicus in Montpellier—6

Robertus Anglicus—10
Robertus Anglicus in Montpellier—3
Robertus Anglicus of Lincoln (Grosseteste)—6

Robertus Anglicus and Johannes of Montpellier—1
Robertus Anglicus and Johannes of Sacrobosco—1

These attributions come from a variety of sources. Among the sixty-five manuscript copies collated in this edition, eleven include some version of Johannes in the title. Five give some version of Robertus, including the one attribution to Robert of Lincoln. Each name appears in the explicit of one additional manuscript. Thus the internal evidence in this edition offers twelve manuscripts attributed to a Johannes and six to a Robertus. The evidence from titles must be weighed carefully, as I discuss in a later section on conclusions. Yet none of these titles or explicits appear in margins or as obvious later additions. Each appears to be in the hand of the scribe who added all of the titles in the treatise.

The solution to the problem of two names will have to be an educated guess, as there is no evidence that settles the question. The only records obtainable from the place of writing are charters from the university. One of these, a statutory act of 1240, contains a list of twelve professors as witnesses to the document and includes both a Johannes Anglicus and a Robertus Anglicus.[39] There is nothing to indicate their interests or their ages. Since the statutory act of 1240 shows the existence there of both persons, each called Anglicus, confusion could easily have arisen in later manuscript copying in the university vicinity. In this area, where the history of the faculty would be known, I suggest that the double attribution could have arisen by scribes changing an attribution from Johannes to Robertus. Since there are no other known works by Johannes, Robertus, the author of the *Commentary* on Sacrobosco's *Sphera*, was probably better known and thus more frequently assumed to be the correct name for an author of works in the same field. For further possible evidence I perused all papal registers from 1216 to 1276, and no additional information was gleaned from this search.

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[38] Poulle, "Les instruments astronomiques de l'Occident latin . . .," pp. 36–39.

[39] *Cartulaire de l'université de Montpellier*, ed. A. Germain (2 vols., Montpellier, 1890-1912), 1: 186–190.

The one remaining problem in the authorship controversy is the occasional appearance of names other than those of the two key contenders. As mentioned earlier, the name of Robert Grosseteste is attached to six of the manuscripts. According to S. Harrison Thomas, *Quadrans vetus* is sometimes attributed to Grosseteste but is a spurious work. Thomson dismisses the attribution with almost no discussion and relies on Tannery's work for the tradition of the manuscript.[40]

Another name which occurs in connection with one Paris manuscript, Bibliothèque Nationale latine 104070, is that of Robert Kilwardby. This suggestion is from the library catalog, not from the manuscript itself, and can be disregarded easily. Kilwardby, indeed, was in Montpellier in 1271 attending sessions of the Chapter-General of the Dominican Order.[41] Yet, as Tannery points out, if *Quadrans vetus* were his work, this would be his only mathematical treatise, written late in life, and not listed in any of the collections of his works.[42] Quêtif and Échard verify this in the discussion of his life and in their compilation of his works.[43] The suggestion of Kilwardby doubtless comes from the cataloger's attempt to identify the Robertus Anglicus listed in the incipit of the manuscript. A similar error is found in Naples, Biblioteca Nazionale, manuscript VIII C 36, in which the explicit reads: ". . . quadratis (*sic*) Ricardi." This last could easily be a copyist's mistaken reading of an abbreviation for Robertus. No other reference has been found to a Ricardus in this study.

Other suggestions resulting from a variety of misreadings occur occasionally in the manuscripts. For example, Johannes Regiomontanus is credited with the work in Wolfenbüttel manuscript 1127 Helmstedt, dated 1475. Regiomontanus (or George Peurbach, a contemporary with whom he was often confused by catalogers) did indeed write on the quadrant, a treatise beginning "Describe quartem partem circuli more vulgato. . . ."[44] A late fifteenth-century copyist, especially in Germany, might easily have read an abbreviated form of Johannes de Monte Pessulano as the perhaps familiar Johannes Regiomontanus, a contemporary (1436–76). A more plausible candidate in regard to the date of writing is Arnold of Villanova; his name appears in the catalog for Munich, Codex Latinus Monacensis 27105, a fifteenth-century manuscript. Arnold was indeed flourishing during the late thirteenth century and did spend part of his life in Montpellier. Yet, in a list of more than eighty of Arnold's writings and of seventy-six editions of his various works, George Sarton does not include one work on astronomy or astronomical instruments.[45] The major portion of his work is devoted to medical writing; his interests seem generally to lie in the natural sciences. Of the more than four hundred entries under his name in Thorndike and Kibre, not one pertains to astronomy or astronomical instruments.[46] Thus, he seems hardly worth consideration as an author of *Quadrans vetus.*

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[40] S. Harrison Thomson, *The Writings of Robert Grosseteste* (Cambridge, 1940), p. 261, item 53.

[41] *The Dictionary of National Biography*, ed. Sir Leslie Stephen and Sir Sidney Lee (22 vols., London, 1921–1922), 11: 120.

[42] Tannery, "Traité du quadrante," p. 136.

[43] Jacobus Quêtif and Jacobus Échard, *Scriptores ordinis praedicatorum* (2 vols., Paris, 1719–1723), 1, 2: 374B; cf. also the *Dictionary of National Biography*, 11: 121–122.

[44] Thorndike and Kibre, *Catalogue of Incipits*, col. 401, attribute this work to Regiomontanus.

These infrequent suggestions have almost no bearing on the basic controversy of Robertus versus Johannes except in the instances of the same given name. In these cases, as in that of Robert Grosseteste, they probably arose from a copy attributed to the original Robertus or Johannes and, as such, should be considered as supplementary evidence for one of them. Given the above evidence, one seems justified at this point to attribute the work to Johannes Anglicus of Montpellier. He will be the assumed author in this edition.

The dating of the treatise and the place of writing are less difficult problems than the authorship, and information on these matters adds circumstantial evidence to my conclusion on the authorship. Concerning the date of writing, the evidence available in the manuscript copies must be studied. The earliest certain evidence we have is from a Milan manuscript, H 75 suppresso, which is dated internally as 1284.[47] An early Cambridge copy, Ii III 3, contains the date 1299 on a chart within the text. It is dated 1276 by Paul Tannery and Robert Gunther, but the evidence does not support their conclusion.[48] Nine others have been determined as thirteenth-century copies, either from evidence within the manuscripts or by catalogers of the collections in which they are found. One can safely say that the treatise was written sometime prior to 1284.

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[45] Sarton, *History of Science,* 2: pp. 893–898.

[46] Thorndike and Kibre, *Catalogue of Incipits,* cols. 1746–1748.

[47] The colophon, on f. 73r^{a} and in the same hand as the remainder of the manuscript, states, "Factum anno domini 1284 ·2^{a}· die iulii in die dominica. Sole existente in ·17°· gradu cancri. luna ·20°· gradu aquarii. Saturno ·20· capricorni. Jove ·21· Sagittarii. marte ·13· virginis. venere ·18· leonis. mercurio ·28· gemini. capite ·12· capricorni ante meridiem inceptum . . . Explicit."

[48] Robert Gunther, *Early Science in Oxford* (14 vols., Oxford, 1920–1940; reprinted, London, 1967–1968), 2: 161 (all citations are from the reprinted edition). He describes the drawing of a quadrant in the manuscript, f. 57v, and says it is dated 1276. If he means the instrument is so dated internally, I have not found any such date on the drawing. Immediately above the drawing is the chart of the sun's place in the zodiac; this chart is dated 1299. Gunther, ibid., 5: p. 134, again uses this date for the manuscript in his version of another of its treatises, Messahala's work on the astrolabe. Once more he gives no evidence for the date. Paul Tannery, "Traité du quadrant" p. 131, gives the date 1276 without comment. Thorndike and Kibre, *Catalogue of Incipits,* col. 585, list the manuscript as 14c. Considering the evidence, I am using the date ca. 1300.

As to the place of writing, there is both internal and external evidence for the tradition of Montpellier. Within the text, in paragraph 44, the latitudes of two places, Montpellier and Paris, are used as examples in a problem of computing time in given latitudes. The use of Paris as the key city in France and its environs would be normal, but that of Montpellier would be less likely without some immediate or personal reason. In addition to this internal evidence, there is support for this location in some titles, explicits, and tables of contents of the manuscripts. However, tables of contents are frequently in later hands and are therefore insecure evidence; I have used titles and explicits as more dependable documentation. Nine of the sixty-five manuscripts collated in this edition include the city in their titles, and others include it in their explicits. These titles are usually in the same hand as all other titles throughout the treatise. No other city is mentioned in any title except that of the manuscript attributing the work to Robert of Lincoln.

The choice of Montpellier as a source of such writings in the thirteenth century is certainly reasonable. According to Rashdall, the town was the site of a medical school dating from circa 1137. The earliest extant record of this is found in a confirmation of existing statutes for the school, issued in 1220 by Cardinal Conrad de Porto.[49] The university was officially chartered in 1289 by a bull of Pope Nicholas IV, but there were in residence a number of scholars other than medical professors several decades prior to that year.[50] According to Rashdall, this is not unusual, as a number of universities in the Mediterranean area were in operation long before receiving a papal bull of foundation. Indeed, some never received them.[51] This practice would have been quite appropriate for Montpellier, since the city was held by the King of Navarre during this period. Probably the university was well developed by the 1230's.

Not only were there men of other disciplines in Montpellier, but there were scholars of diverse backgrounds and origins. There was an active chapter of Dominicans, and Robert Kilwardby was there in 1271 during his term as English provincial of the order (1261–1272).[52] Kilwardby's interests certainly were broader than medicine, and his works include commentaries on Aristotle, Boethius, and Peter Lombard's *Sentences*, as well as two original treatises on philosophy: *De unitate formarum* and *De ortu et divisione philosophiae*.[53]

The Dominicans, as well as the Franciscans and Cistercians, had the practice of establishing their schools of general studies in those cities where a secular university existed. (The one exception to this was in Germany, where in the mid-thirteenth century no university as yet existed.) Thus the Dominicans transferred certain of their schools of general studies from

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[49] *Cartulaire* . . ., 1: 180–183.

[50] Hastings Rashdall, *Universities*, 2: 120–123, 130.

[51] Ibid., p. 64.

[52] *The Dictionary of National Biography*, 11: 120.

[53] Ibid., pp. 121–122, and Quétif and Échard, *Scriptores* 1, 2: 374B.

1248 forward, to Bologna, Montpellier, and Oxford. In order to support the school of Montpellier, the provincial in 1250 ordered that the various convents send assistance in gold to Montpellier once each year. According to Denifle, the Cistercians erected a college there in 1252, and the Franciscans also had a school in the city during the second half of the thirteenth century.[54]

Secular scholars as well were in the city, connected with the university. An excellent Spanish example is Ramon Lull, who was in Montpellier on numerous extended visits from 1283 until 1309.[55] Thus, according to the information gathered by Denifle and others, there were a large number of Christian scholars teaching in Montpellier during the last half of the thirteenth century.

Another important group of scholars in the city was a large number of Spanish Jews. Montpellier in the thirteenth century was a part of a holding of the King of Navarre. It was held by him as a fief from the King of France until 1204 and thereafter held freely by him until it passed under the direct sovereignty of the King of France in 1349.[56] As a result, there apparently was a considerable amount of travel between the city and the Spanish peninsula. We are certain that non-Christians were welcome there, and this included Moslems as well as Jews. Indeed, Rashdall maintains that the founders of the medical school are traditionally held to be Arabic and Jewish.[57] Concerning the Jews, Ernst Renan lists a group of forty Jewish scholars who were working in the city in the last half of the thirteenth century.[58]

As for the composition of the student body, Rashdall demonstrates Spanish as well as French influence in the three names of the nations into which the legal university was divided: Provence, Burgundy, and Catalonia.[59] With such a crosscurrent of Christian, Jewish, and Arabic intellectual influences being present in the city and in the university, it is quite reasonable that Arabic interest in mathematics and navigation would spread among the other scholars. This seems a logical place for the composition of such treatises as *Quadrans vetus* and the later *Quadrans novus* of Jacob ben Machir ibn Tibbon during the last half of the thirteenth century. Thus, in summary, the date and location of the treatise *Quadrans vetus* can be assumed to be prior to 1284 in Montpellier. Considering the flourishing of studies and the interaction of various groups from circa 1250, it seems reasonable to date the treatise somewhere between 1250 and 1284. A more narrow time span, 1276–1284, can be argued if one accepts a Castillian treatise compiled by Rabiçag under King Alfonso X as a direct source of our treatise. This more precise dating will be discussed in the following section.

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[54] Heinrich Denifle, *Die Entstehung der Universitäten des Mittelalters bis 1400* (Berlin, 1885; reprinted, Graz, 1956), pp. 348–349 (all citations are from the reprinted edition).

[55] Thorndike, *A History . . .*, 2: 863.

[56] Rashdall, *Universities*, p. 118.

[57] Ibid., pp. 120–121.

[58] Ernst Renan, "Les Rabbins Francais du Commencement du XIV^{e} Siècle," *Histoire litteraire de la France*, ed. Barthelèmy Hauréau, (37 vols., Paris, 1722–1938), 27 (1881): pp. 514–515, 599–624.

[59] Rashdall, *Universities*, p. 121.

B. Literary Tradition and Sources of *Quadrans vetus*

The problem of authorship of the treatise has been rather widely discussed, but the question of sources for the document remains. In the manuscripts the work is presented as the original composition of one man, and Paul Tannery in his 1897 edition maintained this view.[60] Yet I have found that at least 80 percent of the treatise is very similar to material in two other works. The first of these, entitled *Practica geometrie,* is a treatise which I believe to be an earlier Latin work, perhaps of the twelfth century.[61] It is of unknown origin and has an incipit which is almost identical to that of *Quadrans vetus*: "Geometrie due sunt partes principales theorica et practica . . ."; the addition of the word *principales* distinguishes it from the other. This treatise will be discussed later in this section, and an edition of the document based on fourteen manuscripts is included in this volume. Because of the strong similarity and apparent close relationships between it and *Quadrans vetus,* its origins will be traced along with those of the latter work throughout this section. To avoid confusion among the various medieval treatises entitled *Practica geometrie,* I shall refer to this one by the shortened but distinctive incipit, *Geometrie due sunt partes principales* for the remainder of this volume. The second possible source is a treatise on the old quadrant found in the *Libros del saber de astronomia del Rey D. Alfonso X de Castilla,* a compilation of Spanish translations of Arabic works produced under the direction of Alfonso X in 1276–1277.[62] An analysis of this treatise and comparison of it with *Quadrans vetus* is included in this section.

To see these two possible sources of *Quadrans vetus* in a proper historical context, we should first review the earlier literature in this genre. A perusal of some writings of the previous several centuries shows great similarity in their content and order and in the types of instruments used. The earliest of the instruments described is the astrolabe, a device based on the principle of stereographic projection.[63] The oldest known reference to this principle is by Appolonius of Perga (fl. 200 B.C.) in the first book of his *Conics*.[64] The first use of it, according to O. Neugebauer, is by Hipparchus (160–125 B.C.). Neugebauer maintains that Hipparchus did not know spherical trigonometry, but he did handle problems of spherical astronomy and thus he must have been able to project spheres onto plane surfaces in order to solve these problems.[65] The first extant treatment of the astrolabe itself is a detailed description of the instrument given by Ptolemy is his mid-second-century work entitled *Planisphaerium*. Some scholars have held that this treatise is only theoretical in nature and that Ptolemy did not know of an actual instrument. Yet Neugebauer in writing on the early history of the instrument quotes from a Latin text of Ptolemy's work to demonstrate that the construction of the instrument was known to Ptolemy: ". . . Huius series habet equidistantes zodiaco, quoisque assignent loca stellarum fixarum, qua ratione ea contineat id, quod in horoscopio instrumento aranea vocatur."[66]

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[60] Tannery, "Traité du quadrant" p. 127.

[61] This work has not been edited previously. It is identified in Thorndike and Kibre, *Catalogue of Incipits,* col. 585. The earliest manuscript copies I have found are British Library, Royal 12 E XXV, 152r–155r, and Venice, Bibliotheca Marciana, fondo antico, 332 (XI, 6): 236v–239v, both dated thirteenth century. Marshall Clagett has demonstrated through internal evidence that the treatise is late-twelfth or early-thirteenth century. See Marshall Clagett, *Archimedes in the Middle Ages* (4 vols., Madison, Wisconsin, and Philadelphia, 1964–1980), 3 pt. 2: 215–217. The edition of *Practica geometrie* to which Professor Clagett refers on p. 215, note 8, is a part of my doctoral dissertation, submitted to Emory University under my former name, F. N. L. Britt. The edition of *Quadrans vetus* to which he refers on p. 217, notes 10 and 11, also appears in that volume under my former name.

[62] *Libros del saber de astronomia del Rey D. Alfonso X de Castilla,* ed. Manuel Rico y Sinobas (5 vols., Madrid, 1864).

Neugebauer continues his history of the astrolabe, moving to Theon of Alexandria in the late fourth century. It is not clear whether Theon copied Ptolemy exactly in his writing on the instrument, but it is obvious that he transmitted the material, either directly or through a commentary.[67] The tradition continues through Philoponus, sixth century, and Sebohkt, mid-seventh century, both of whom produced treatises on the astrolabe, and their contents are very close to the work of Theon.[68] The knowledge of the principle involved and of the construction of the instrument is thus preserved through the seventh century. It continues in the eighth century in the work of Messahala.

Messahala's treatise, *De operatione vel utilitate astrolabii*, includes what would seem to be the first discussion of the next instrument in our series, a device later called the *quadrans vetustissimus*. In one of the earliest extant Latin copies of this work there are directions for drawing a double quadrant on the dorsal side of the astrolabe.

> Cum volueris ponere quadrantem umbre, iunge cuspidem circuli signorum per lineam subtilem et occultam, que vadit per medium quarte occidentalis et septem-

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[63] For a recent discussion on the history of the astrolabe, see Ron B. Thomson, ed., *Jordanus de Nemore and the Mathematics of Astrolabes: De plana spera* (Toronto, 1978).

[64] Apollonius, *Conics*, trans. R. Catesby Taliaferro (*Great Books of the Western World*, 11: Chicago, 1952), Book 1, proposition 5, pp. 607–608. For a view of his possible dependence on his predecessors, cf. G. J. Toomer, "Apollonius of Perga," *Dictionary of Scientific Biography*, ed. Charles Coulston Gillispie (16 vols., New York, 1970–1980), 1: 179–193.

[65] Otto Neugebauer, "The Early History of the Astrolabe," *Isis*, 40 (1949): 246.

[66] Ibid., 242; cf. J. D. Drecker, "Das Planisphaerium des Claudius Ptolemaeus," *Isis*, 9 (1927): 255–278.

[67] The treatise by Theon is no longer extant. Neugebauer uses a table of contents for the work recorded by Yá qubi (fl. 875), which he quotes from M. K. Klamroth, *Ueber die Auszüge aus griechischen Schriftstellern bei al-Jâ qubi. IV. Mathematiker und Astronomen. Zeitschrift d. Deutschen Morgenlandischen Gesellschaft*, 42 (1888): 1–44.

[68] Ibid., 240. For Philoponus, cf. Paul Tannery, "Jean le grammarien d'Alexandrie, (Philopon), Sur l'usage de l'astrolabe et sur les tracês qu'il prêsente," *Memoires scientifiques*, 9: 341–367. For Sebohkt, cf. Robert Gunther, *The Astrolabes of the World*, 2 vols. (Oxford, 1932), 1: 82–103.

trionalis equaliter, cuius finis erit circulus mensium. Postea produces ex fine eius •2• lineas ad summitatem tabule, et erit quadrans erectis angulis. Deinde facias post ipsas duas lineas alteras prope eas, inter quas erunt puncti. Item facias alias •2• lineas latiores inter quas erunt littere, et divides spacia que sunt inter has lineas ex utraque parte per •6• divisiones ad letteras. Spacium vero quod est strictius divides per •12• secundum numerum punctorum, ad unamquamque letteram •2• punctos, et incipies scribere ex diametris.

Et si vis in astrolabio •2• quadrantes, facies in alia •4• septemtrionali scilicet et orientali, que est iusta eam similiter. Potes etiam inter quadrantes •2• eosdem infra circulum mensium constituere lineas horarias, ut fit in quadrante, per quas etiam horas dies (sic) naturales in dorso. Ut patet in figuris supra habitis.[69]

This quadrant includes a shadow square and the six hour lines for measuring the unequal, or natural, hours. Immediately following are paragraphs on construction of an alidade and sights for observation, standard parts of the dorsal side of an astrolabe. Taken together, these elements, the shadow square, hour lines, alidade (or often a plumb line with a sliding bead), and sights for observation, comprise the essential parts of the *quadrans vetustissimus*. This juxtaposition of the parts of this very early quadrant could be accidental. Yet the text refers to some type of quadrant ("ut fit in quadrante"), and a passage in the usage section of the treatise makes an even stronger case for a conscious juxtaposition of the parts of the instrument.

De eodem inveniendo per lineas.

Item per allidadam in dorso et lineas horarum inter latera gnomonis, si sint posite ut in quadrante, sic. Super altitudinem solis meridianam in illa die pone allidadam; et nota ubi meridianus circulus, id est, linea finis •6• hore, secuerit lineam fiducie ipsius allidade; et pone ibi signum de incausto; et illud signum valet situationem margarite in quadrante; deinde accipe altitudinem solis in quacunque horá vis et illud signum inter horas dabit horam naturalem, ut in quadrante.[70]

The reader is directed to use the alidade as one would a plumbline with a sliding pearl. The plumbline with its pearl is a part of the later *quadrans vetus* and of other quadrants as well as the *quadrans vetustissimus*. This substitution indicates that the writer probably is familiar with more than one type of quadrant, perhaps among others the *quadrans vetustissimus*.

Messahala's complete treatise is not available in early manuscripts, but one of the oldest extant copies is in the Cambridge University Library manuscript quoted above, dated circa 1300. Robert Gunther printed a version of the treatise based on this copy in 1929, but his production must now be considered unreliable.[71] If the entire work as Gunther presented it was that of Messahala and was not altered by excessive interpolation, it would indeed include the first description of the *quadrans vetustissimus*. However, certain questions arise.

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[69] Cambridge University Library, manuscript Ii III 3, ca. 1300, f. 62v. Francis J. Carmody maintains that the earliest Latin translation of the work is by John of Seville, mid-12c. Cf. Francis J. Carmody, *Arabic Astronomical and Astrological Sciences in Latin Translation: A Critical Bibliography* (Berkeley, 1956), pp. 23–24.

[70] CUL, ms. Ii III 3, f. 75r.

[71] CUL, ms. Ii III 3, ff. 61r–79r; Gunther, *Astrolabes*, 1: 195–231. See Ron B. Thomson, *Jordanus de Namore*, pp. 53–55 and 179–185, for a discussion of the Gunther version and a more recent rendition of a portion of the treatise.

Gunther's version, if correct, provides sufficient evidence for the eighth-century existence of all parts of the *quadrans vetustissimus* and, thus, all of the *quadrans vetus* except the cursor. Yet research by J. Millás Vallicrosa contradicts this. In an article published in 1932, Millás maintains that the two sections of Messahala's work that concern the quadrant are interpolations.[72] He begins his argument by pointing out that Gunther's version is based on a late thirteenth-century manuscript, with some corrections and variations from the Bodleian Ashmolean manuscripts 1522 and 1796. Millás compared this edition with the printed one of Gregor Reisch in his *Margarita Philosophica*, fourth edition dated 1512.[73] He shows the Reisch edition to be considerably different and shorter than the Cambridge and Ashmolean manuscripts. Gunther had recognized this and rather quickly dismissed the early printed edition as less correct than his own.[74] Millás maintains that Gunther's own edition includes items that could not be other than interpolations: the name of al-Battani, who died in 929, and the presence of a "Tabula stellarum fixarum verificatarum per armillas Parisius."[75] In short, he does not feel that the Gunther edition as a whole is dependable. Regarding the two chapters on the quadrant, he remarks that both occur at the end of their respective sections in Gunther's source texts and are probably later additions to the text. He also cites derivatives from Messahala which were written closer to his own time, those of Ali ben Isa, Maslama, Aben Safar, and Abusalt de Denia, and maintains that none of these treatises on the astrolabe include the material on the quadrant.[76] Millás' arguments are based on circumstantial evidence, but taken together, their credibility is great enough to make it unbelievable that Gunther's version is the original of Messahala. Thus, there is not sufficient evidence at this moment to hold that either the *quadrans vetus* or the *quadrans vetustissimus* was known in the eighth century. We must move to the late-tenth or early-eleventh century for this development.

The first significant step in the evolution of the old quadrant is the addition of the cursor, or sliding plate, in the limbus of the quadrant. The earliest document in which one finds a chapter describing a quadrant with a cursor is the anonymous *Geometria incerti auctoris*. A fragment of the work exists from the tenth century, and it is a practical complement to Gerbert's theoretical work, the *Geometria*. It was included in some manuscripts containing Gerbert's work in the eleventh century. Bubnov cites four eleventh-century copies of all or most of the document.[77] Millás cites one fragment of the treatise from the tenth century and two from the eleventh century.[78]

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[72] J. Millás Vallicrosa, "Introducción del cuadrante," pp. 218–258.

[73] Ibid., 254. Contents of this and other editions of the *Margarita Philosophica* are discussed in Wilberforce Eames, *A List of Editions of the Margarita Philosophica, 1503-1599* (New York, 1886).

[74] Gunther, *Early Science in Oxford . . .*, 2: 135.

[75] Millás, "Introducción del cuadrante," pp. 218–258; cf. Gunther, *Early Science in Oxford . . .*, 2: 202, and CUL Ii III 3, f. 71r.

[76] Millás, "Introducción del cuadrante," p. 257.

The anonymous author describes the use of an astrolabe for observational purposes and for the solution of practical problems. In several measuring problems he also suggests alternate solutions by use of rods and mirrors. It should be noted that both *Geometrie due sunt partes principales* and *Quadrans vetus* later use this pattern. The author also discusses problems under the classifications of altimetry, planimetry and steriometry, the same divisions used later in the two last-mentioned treatises. However, the author solves the majority of his problems through use of the astrolabe, particularly the dorsal side, which contains a quadrant.

Bubnov, in his monumental edition of the mathematical works of Gerbert, proved that the *Geometria incerti auctoris,* including chapters XVI through XCIV in Gerbert's *Geometria,* is anonymous and suggested it as a source for the part of the *Geometria* which is authentic Gerbert.[79] It was Bubnov who gave this portion the name *Geometria incerti auctoris.*

Our concern is with the sixth and seventh chapters of the anonymous work, chapters XXI and XXII of Gerbert's *Geometria.* This portion includes an explanation of how to find the time by means of a quadrant with a cursor. Millás points out that this section appears as a part of the treatise only in certain copies and that it follows the work in other manuscripts.[80] Because of its occasional omission and displacement, Bubnov regarded it as a later interpolation.[81] Millás argues that this is an incorrect designation, as the material appears in the tenth-century manuscript Ripoll 225, folio 20r-v, along with other chapters taken from the *Geometria incerti auctoris.*[82] The quadrant described is not the same as the old quadrant of the thirteenth-century writings but it does have a cursor, which eliminates the necessity of having solar declination tables to accompany the instrument. There is a "tenth circle," an arc of the apex, for measuring the shadow of the sun. Millás identifies this as a common substitution for the shadow square in spherical astrolabes and in Jacob ben Machir ibn Tibbon's new quadrant of the late thirteenth century.[83] It is less convenient than the shadow square but nonetheless effective for its purpose.

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[77] *Opera Mathematica Gerberti,* ed. Nicolaus Bubnov (Berlin, 1899; reprinted, Hildesheim, 1963), p. 47 and pp. 311–317 (citations are from reprint edition). In his list of manuscripts containing both items, Bubnov includes the following eleventh-century copies: British Library, Royal 15 B IX, ff. 61r–68v; Munich 14836, ff. 53r–68r, ff. 45r–52v (fragment); and Paris, Bibliothèque Nationale, latin 11238, ff. 18r–32v.

[78] Millás, "Introducción del cuadrante," p. 227, cites fragments of the contents in the manuscript 225, f. 21r-v, of Santa Maria Monastery, Ripoll, 10c; in Leiden, Scalinger ms 38, f. 46 v, 11c; and in Rome, Vatican, Regina Sueviae ms 598, f. 119r, 11c.

[79] *Opera Mathematica Gerberti,* p. 46 and pp. 310–311.

[80] Millás, "Introducción del cuadrante," p. 222. He cites British Library, Royal 15 B IX, 11c; here *Geometria incerti auctoris* occupies ff. 61r–68v, other related works including letters of Gerbert follow, and this short entry appears on f. 70r, following the letters. Cf. also the citations by Millás in note 19.

[81] *Opera Mathematica Gerberti,* pp. 46–47 and 321–322.

[82] Millás, "Introducción del cuadrante," p. 223.

[83] Ibid., p. 229.

Another document of concern from this period, frequently cited as the work of Gerbert, is the *Liber de astrolabio,* dated by Haskins as tenth century.[84] The work describes an astrolabe whose dorsal side contains the same quadrant described in *Geometria incerti auctoris.* The material is similar in format, content and style to *Geometrie due sunt partes principales.* One should recall, however, that many of the scientific treatises of the period share these features. Here, as in Messahala's work on the astrolabe, there are many short chapters beginning "Si vis scire. . . ." *Geometrie due sunt partes principales* shares much with this earlier work and could have been derived from it, but this has not been proved.

The next treatment of a quadrant is that found in the *Liber secundus de utilitatibus astrolabii.* The work is a miscellaneous collection including, among other things, descriptions of a cylindrical clock, various instruments for the measurement of the earth, and a quadrant with a cursor. The passage on the description of the quadrant occurs in the fifth chapter. A notable difference between this instrument and other quadrants with cursors is its method for telling time. It uses straight lines extended from the right side of the apex to the first arc of the angle, rather than the customary curved time lines from the apex of the old quadrant. Tannery maintains that this change involves a different principle for telling time.[85] Actually, according to Millás, the principle is the same. The sixty points from the right side of the instrument divide the arc into sixty parts rather than the six divisions of the time lines of the old quadrant. The latter method provides the same trigonometric information and is more convenient and quicker to use in the calculation of the hour.[86] The considerable difference between the two is the use of an arc in place of the shadow square of the old quadrant. This variation we have already seen in the instrument of the *Geometria incerti auctoris* and a fragment of the *Liber de astrolabio.*

The *Liber secundus de utilitatibus astrolabii* has been attributed to Hermannus Contractus, who died in 1054. According to Millás, the title is a misnomer and the work may not be that of Hermannus,[87] but this does not invalidate the placing of this treatise early in the eleventh century. Tannery cites this work as the oldest mention in the Latin West of a quadrant with a cursor although it has a different name, *quadra astrolabii.*[88] A diagram of the instrument appears in the manuscript Vatican Regina

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[84] *Opera Mathematica Gerberti,* pp. 109–147, contains an edition of it and attributes it to Gerbert. C. H. Haskins, in *Studies in the History of Mediaeval Science* (Cambridge, Mass., 1924; reprinted, New York, 1967; citations from reprint edition), p. 9, maintains that the evidence is too insecure to hold Gerbert as the author. He also cites a tenth-century fragment, found in Ripoll ms. 225, which Bubnov does not list.

[85] Tannery, "Traité du quadrante," pp. 143–144.

[86] Millás, "Introducción del cuadrante," p. 235 and pp. 240–242, in which he gives a long discourse demonstrating the use of both quadrants.

[87] J. D. Drecker, "Hermannus Contractus Über das Astrolab," *Isis,* 16 (1931): 203–212; Drecker, 203, cites a fragment of this work in Munich 14836, 11c, and the earliest extant full copy as Salzburg Codex a.v.7, which he dates between 1127 and 1160. Millás, "Introducción del cuadrante," p. 237.

[88] Tannery, Traité du quadrante," pp. 143–144.

Sueviae latina 1661, folio 86v, eleventh century. Another such diagram appears in the manuscript British Library, Royal 15 B IX, folio 71r, eleventh century, with one variation: the arc of ninety degrees moves from right to left, rather than vice versa. Chapters describing the instrument appear in the Vatican manuscript, folio 86r-v, and the British Library Manuscript, folios 70v–71r. There are also descriptions in Avranches manuscript 235, folios 67v–78v, and Oxford, Corpus Christi College manuscript 283, folio 105v, late twelfth century.

These various tracts, covering some two centuries, represent the types of literature in general circulation in Europe on the subject of the quadrant with cursor prior to the twelfth century. The version of the quadrant with cursor of this period is somewhat different from the *quadrans vetus*, but the differences are not in matters of principle. They are, rather, differences in methods of carrying out these principles, methods that are simpler and more accurate in the *quadrans vetus* of the thirteenth century than in the older instrument.

A more plausible source for the contents and tradition of *Geometrie due sunt partes principales* is the work attributed to Hugo of St. Victor, dated circa 1140 and entitled *Practica geometriae.*[89] This work follows the *Geometria incerti auctoris* of the previous century more closely than any other work. The measurement problems discussed in Hugo of St. Victor's treatise require chiefly the dorsal side of the astrolabe, as do those in the *Geometria incerti auctoris*. In addition, Hugo's *Practica geometriae* includes alternate suggestions for measurement of inaccessible heights by use of mirrors or of saucers and shells filled with water. There are also directions for the use of rods in measuring heights, depths of pits, and other common dimensions of the types discussed in the *Geometria incerti auctoris*.

An important similarity between Hugo of St. Victor's work and *Geometrie due sunt partes principales* is Hugo's adoption of a division made by Macrobius in his fifth-century *Commentary on the Dream of Scipio*. The latter uses the terms *theorica* and *practica* in describing divisions in philosophy, applying *theorica* to abstract studies and *practica* to applied philosophy, or ethics.[90] Hugo adopted this division for philosophy in his earlier *Didascalicon* and then adapted it to geometry in his work on that topic. The author of *Geometrie due sunt partes principales* uses the same adaptation, to abstract versus applied geometry. In addition, these two authors share the use of the triad of altimetry, planimetry and steriometry as the divisions within applied geometry. Although these categories are informally applied in earlier works, Hugo is the first author to define them and use them formally as divisions of his treatise.[91]

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[89] Hugo of St. Victor, *Hvgonis de Sancto Victore Opera Propaedevtica: Practica geometriae, De grammatica, Epitome Dindimi in philosophiam*, ed. Roger Baron (Notre Dame, 1966), pp. 15–64.

[90] Macrobius, A. A. T., *Commentary on the Dream of Scipio*, trans., W. H. Stahl (New York, 1952), p. 246.

[91] Hugo, *Opera Propadevtica*, p. 17.

The tradition begun in the earlier works has thus become more explicit and defined in the work of Hugo of St. Victor. The writings in the tradition, taken as a group, certainly form an adequate background for the composition of *Geometrie due sunt partes principales*. The problem of the sources of the latter treatise would be solved if one could show a direct connection between Hugo's treatise and this work. This is difficult to accomplish for two reasons. There is still some dispute as to who actually wrote the work attributed to Hugo; previous scholars have maintained that the treatise is later, that it does not appear in various collections of his works, and that it is inferior to his writing.[92] The more recent scholarship is that of Roger Baron, who maintains that it is indeed the work of Hugo. Baron has attempted to refute the earlier arguments but has not completely destroyed them.[93] Thus the date of Hugo of St. Victor's death, 1141, is not necessarily the latest possible date of the composition of this treatise. It possibly could be too recent to be a source for *Geometrie due sunt partes principales*.

The second problem I have encountered in relating Hugo's work to *Geometrie due sunt partes principales* is that I have found no evidence for a precise dating of the latter treatise. The earliest manuscript I have found is cataloged as thirteenth-century.[94] Since the instrument described and the solutions to the problems presented are more primitive than those found in *Quadrans vetus*, I maintain that *Geometrie due sunt partes principales* is perhaps a century older than *Quadrans vetus*.[95] One can only surmise that Hugo's treatise might have been an important source for the writer of *Geometrie due sunt partes principales*. Even so, the pattern of writing used in such treatises on instruments had its beginning as far back as the tenth century in Europe and was certainly well-established by the middle of the twelfth century.

With a tradition of style and content established, we can now approach the question of the possible immediate sources of *Quadrans vetus*. Several other treatises in Latin which discussed the instrument were written and distributed in Europe prior to 1284, the date of our earliest extant copy of *Quadrans vetus*.[96] Guillelmus Anglicus of Montpellier or Marseilles referred to the instrument in 1231, in his Latin rendition of the eleventh-century Arabic treatise by Arzachel on the saphea, or astrolabe. Guillelmus's work, as preserved in a fourteenth-century Latin manuscript in Paris, instructs the reader to construct a quadrant without the cursor but with hour lines, shadow square, and the substitution of an alidade for the usual plumbline and sliding pearl.[97] The manuscript has on folio 74v a fine drawing of the dorsal side of the astrolabe with all the mentioned parts shown. L. Am. Sedillot in 1844 maintained that this quadrant is the *quadrans vetus* minus its cursor, an item obviously not needed on the dorsal side of an astrolabe. Sedillot based his comments on an Arabic copy of Guillelmus's text, preserved in Paris.[98] Yet this instrument, as illustrated by Sedillot, differs noticeably from the old quadrant; it has lines of projection similar to those of the *quadra astrolabii* of Tannery's description, not the hour lines of the old quadrant.[99]

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[92] Paul Tannery, *"Practica geometriae," Memoires scientifiques*, 5: 204–210.

[93] Hugo, *Opera Propadevtica*, pp. 4–6.

[94] *Catalogue of Manuscripts of the King's Library*, compiled by David Casley (London, 1734), pp. 210–211; the manuscript is British Library, Royal 12 E XXV.

[95] Cf. below, text of *Geometrie due sunt partes principales*, paragraph 17, and text of *Quadrans vetus*, paragraphs 4–31, for a comparison of the instruments described. Marshall Clagett supports the dating of *Geometrie due sunt partes principales* as late twelfth or early thirteenth century for other, different reasons. Cf. note 65 and Clagett, *Archimedes*, 2: 213 and 215–217.

[96] Milan, Bibliotheca Ambrosiana, H 75 sup., ff. 52r–56v.

Arzachel's quadrant had another major difference from our old quadrant. On the left or north side of the quadrant a rectangular groove is to be made extending from the apex to the point on this side where the arc of ninety degrees begins. This groove then intersects the arc which is to be the top of the cursor. The outer edge of this groove must be strong enough not to break. There should be attached to it a mobile indicator, or cursor, as Sedillot renders the Arabic.[100] (The description is unclear here. A cursor is an arc-shaped form, such as is attached above the limbus. Yet the groove is rectangular, on a straight side of the quadrant, and the edge of it, or an attachment within it, must be mobile within the groove. None of this is shown in Sedillot's diagram in Plate 4, figure 14.) There is attached to the indicator in the groove a nail which is to be mobile on its base within the groove.[101] From this nail hangs the string or plumbline which is used to determine the declination of the stars and other information similar to that gleaned from the plumbline of the old quadrant. From the point of intersection of this groove and the arc of elevation, or ninety degrees, additional arcs are drawn to the right, or west, side of the quadrant. These arcs intersect this side to divide it into ninety equal parts. Thus, we have the preparation for the lines of projection, mentioned earlier.[102]

Guillelmus appears to be the first western writer to substitute the hour lines for the old lines of projection. These two means of measuring time differ only in method, as explained earlier. Yet the instrument attributed to Arzachel cannot be identified as the old quadrant.

Guillelmus Anglicus's treatise on the construction of Arzachel's saphea was soon followed by a widely circulated work on the use of this instrument written by Jacob ben Machir ibn Tibbon and John of Brixia in Montpellier in 1263. This treatise immediately follows the work on construction in the Paris manuscript, Bibliothèque Nationale latine 7195, folios 78ra–91vb, ending with the following: "Explicit liber tabule que nominatur saphea patris ysaac arzachelis cum laude dei et eius adiutorio translatum est hoc opus apud montem pessulanum de arabico in latinum in anno domino nostri ihesu christi 1263 Profatio gentis hebreorum vulgarizante et Johanne Brixiensi in latinum reducente Amen." In their discussion of the use of the saphea, the translators include the elements of the old quadrant which by now have been incorporated onto the back of the saphea. The shadow square and unequal hour lines on the dorsal side of an astrolabe had been noted by Raymond of Marseilles before 1141.[103] The substitution of the hour lines and shadow square on Arzachel's saphea by Guillelmus some ninety years later is hardly surprising. Yet it was the first discussion in Latin of the basic features of the old quadrant combined in one instrument. Guillelmus has instructed his readers to take the features of our old quadrant, excepting the unnecessary cursor, and incorporate them into the dorsal side of the astrolabe. Writing in 1231, he does not claim for himself a new invention; rather, he refers to the old quadrant as though it was a relatively well-known instrument. The same was true thirty-two years later for Jacob ben Machir ibn Tibbon and John of Brixia on the use of the saphea. Thus, by 1231 the *instrument* was well known in the Latin West; we shall have to look elsewhere for direct sources of our treatise.

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[97] Paris, Bibliothèque Nationale manuscrit latine 7195, folios 74rb–78ra.

[98] Paris, Bibliothèque Nationale, manuscrit arabe 1148, folios 22–23; L. Am. Sedillot, *Mémoire sur les instruments astronomiques des Arabes. Mémoires présentés per divers savants a l'Academie Royale des Inscriptions et Belles-Lettres* (1^{e} serie, Paris, 1844), 1: 104 and Plate 4, figure 14.

[99] Millás, "Introducción del cuadrante," p. 249. See also Sedillot, *Mémoires*, p. 104.

[100] Sedillot, *Memoires*, pp. 104–105.

[101] Ibid., p. 105.

[102] See Millás, "Introducción del cuadrante," p. 237, and Sedillot, *Memoires*, pp. 30 and 104, and Plate 4, Figure 14.

The next work of note on the old quadrant is that of Johannes Sacrobosco, the thirteenth-century author of the well-known tract *De Sphera.* His treatise on the quadrant has the incipit, *Omnis scientia per instrumentum operative. . . .*[104] In contrast to the work of Guillelmus, Jacob ben Machir and John of Brixia, Sacrobosco's work is solely on the old quadrant. The content and date of the treatise necessitate its consideration as a possible source of *Quadrans vetus.*

Sacrobosco's *Omnis scientia per instrumentum operative* opens with a rather brief section on construction of the *quadrans vetus* without its cursor and the use of bissextile tables for this version of the instrument. It then discusses the cursor, its construction and use. Directions are given for several operations of the quadrant; these include taking of the declination of the sun, of one's altitude, and of the time of day. There follows a brief section on the measurement of heights of objects by use of the shadow square. This is the extent of the usage section of the treatise.

The general style and format of the treatise are not that of Hugo's *Practica geometriae,* the *Geometrie due sunt partes principales* or *Quadrans vetus.* The importance of Sacrobosco's treatise to the history of the old quadrant is that in it the instrument was described in Latin by the middle of the thirteenth century. This brief treatise is not a part of the stylistic tradition of earlier works previously discussed. However, it does demonstrate that an alternate literary style was used by some writers of such treatises in the thirteenth century. Yet apparently the more popular style was that discussed earlier in this chapter and followed by the author of *Quadrans vetus*. This is evident in Thorndike's discussion of manuscripts containing Sacrobosco's *De Sphera*. *Quadrans vetus* is frequently substituted for Sacrobosco's own work on the quadrant in manuscripts which contain other treatises by him.[105]

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[103] Poulle, "Les instruments astronomiques de l'Occident Latin . . .," p. 39.

[104] The New York Public Library, manuscript 69, ff. 70r–79v, and Lynn Thorndike, *The Sphere of Sacrobosco and Its Commentators* (Chicago, 1949), pp. 3–4 and 68–69.

With a tradition of style and content established for treatises on instruments, one can deal with the possible immediate sources of our major treatise, *Quadrans vetus*. The first of the documents to be considered is a selection in the *Libros del Saber*, the series of astronomical works which were compiled under the direction of Alfonso X in Castile in 1276–77.[106] This collection includes direct translations from Arabic sources, adaptations from Arabic material, and original contributions by the scholars at Alfonso's court. Most of the translations in the series have been identified, but the one work on the quadrant has not been traced to its source. King Alfonso, in his short prologue to this treatise, states that the first section of the treatise, on the construction of the old quadrant, was composed by his court astronomer Rabiçag of Toledo. He says that the second portion of the work, on the use of the instrument, was edited by Rabiçag from a very ancient anonymous book. The king does not indicate whether the original source was in Arabic, but translations in his collection were almost exclusively from that language. He says only that the material was a translation of records of observations in earlier manuscripts; this could refer to Latin, Greek, Chaldaic, or Arabic observations of the stars. Alfonso states that his orders to Rabiçag were that the older document should be corrected and completed and that instructions were to be added to it for the precise construction of the instrument. He maintains that "the rules governing the method of construction of the quadrant or quarters of circles that were used with great advantage in astronomy were not to be found written by any ancient author."[107] The work was done in the year 1277.

Rabiçag's treatise on the quadrant opens with a short introduction on its contents and compilation. The first portion, on construction of the instrument, is given in eight chapters; the second part, on usage, contains nineteen chapters. Interspersed throughout the printed edition are drawings of each stage in the construction of the instrument. Chapter one begins with the materials to be used and the exact method of construction by use of geometry with the aid of a compass and a ruler. Chapter two describes the making of the cursor in the limbus of the quadrant; the following two chapters indicate how the cursor should be inscribed. Next, there are chapters on how to make the hour lines, the shadow square, and the alidade. This completes the construction of the quadrant.[108]

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[105] Thorndike, *Sphere* . . . p. 4, n. 15.
[106] *Libros* . . ., 3: 287–316.
[107] Ibid., p. 287; the translation is mine.

Book Two begins with a chapter naming and defining the parts of the quadrant. As the original document did not contain the construction section, this is an appropriate beginning. There follows a chapter on finding the altitude of the sun through the instrument. The next three chapters concern the placement of the cursor for a given latitude and directions for telling time on a particular day. Then there are discourses on the sun in each sign and on the conversion of a position in the zodiac scale to the corresponding day in the Roman calendar. Next, the author discusses problems on deriving the latitude of a given city, whether it is north or south of the equinoctial circle. Other cases concerning the sun follow, in regard to measurement of its shadow in the shadow square. Following this, the author moves to problems of measurements of accessible and inaccessible objects. He then discusses briefly the measurement of the depth of a pit and again of the latitude of a given place, this time by use of a fixed star, rather than the sun. The final chapter concerns determination of the declination of the sun at its zenith on any given day.[109]

The brief summary of the contents gives some indication of the strong parallel between this document and *Quadrans vetus*. The latter work begins with material similar to the introduction in the other apparent source, *Geometrie due sunt partes principales*; yet once the construction of the instrument begins, *Quadrans vetus* is very close to the *Libros* treatise. For example, the first three chapters of the Spanish document are parallel in content, format, and order to paragraphs four through eight in *Quadrans vetus*. Following this, there is some change in the order of the material, but the content of the *Libros* work can be traced nonetheless throughout the first two-thirds of *Quadrans vetus*. There are occasional short chapters in each which do not appear in the other, but these generally are additional explanations or examples. A chapter-by-chapter comparison of the documents appears below in the "Analysis of *Quadrans vetus*," pp. xli–lxv. There one can see that the major differences between *Quadrans vetus* and the *Libros* treatise are in the order of construction of certain parts of the instrument. For example, directions for the hour lines, the shadow square and the sighting tables are interspersed among instructions for the cursor in *Quadrans vetus* but some three chapters later, after the fixing of the plumbline, in the Spanish version.[110] Such arrangements are purely arbitrary and hardly merit notice in a comparison. However, the difference in the complexity of explanation is noteworthy. For instance, in directions for inscribing the cursor, the *Libros* document consumes considerably more space than its Latin counterpart. It directs the reader to inscribe the months by beginning on the left edge with March rather than with January. The measurement is month by month according to the specific degree of the appropriate sign in the zodiac.[111] In *Quadrans vetus* the directions are summarily given to begin on the left edge with January and add so many degrees per month.[112] The *Libros* method is more precise and less liable to error.

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[108] Ibid., pp. 291–308.

[109] Ibid., pp. 309–316.

[110] Cf. infra, pp. 14–16, 19–22 and 40–42.

Among the differences between the two documents are the respective uses of tables. *Quadrans vetus* presents a table in paragraph twenty-nine that gives the position of the sun in the zodiac on the first day of each month; this would be needed information for the construction of the monthly scale on the cursor.[113] The *Libros* does not include this table. It contains another table at the end of Book I that is helpful in constructing the shadow square; this table gives the corresponding position in the limbus scale for every finger and half-finger on the scale of the shadow square. To test the accuracy of the points on the shadow square, one must simply drop the plumbline and check the points at which it crosses both scales.[114] The tables are the major materials not shared by the two versions, and both fall into the category of convenient but nonessential additions.

With the parallels and similarities mentioned earlier, the problem of connecting the two treatises is that of date. The *Libros* document was compiled in 1277, and the oldest securely dated manuscript of *Quadrans vetus* was copied in 1284.[115] One could suggest that the court astronomer, Rabiçag, and the Montpellier scholar, John, had access to copies of common source material on both the construction and the use of the instrument. On the other hand, Manuel Rico y Sinobas, the nineteenth-century editor of the *Libros,* maintains the Rabiçag had in hand a quadrant and simply described the construction of it from his observation.[116] (The originality of Rabiçag's contribution in this section is clearly stated by King Alfonso in his preface to the *Libros* treatise, quoted above.[117]) Had the writer of Montpellier followed the same procedure, the two works would doubtless have been somewhat similar. But the form of presentation, the order of the contents and the texts themselves are too close to be the result of chance. The most plausible explanation is that the author of *Quadrans vetus* followed Rabiçag or, failing that, that they both followed a single Arabic source or a long, rather precise tradition of such works.

Millás Vallicrosa has demonstrated very well the development of a traditional form of presentation of such material. His study of these sources and many additional works in this tradition has shown that a format and style were developing from the time of Gerbert forward.[118] Professor G. J. Toomer thinks that both the *Libros* and the *Quadrans vetus* authors followed the same tradition rather than just one common source. In his view, so much material has been lost, inaccurately described or uncataloged that it is impossible to prove a single source.[119] Yet the internal evidence for a direct connection remains. There is no valid reason to doubt King Alfonso's declaration that the first portion of the *Libros* work was Rabiçag's own, and this is the section we find so very close to its counterpart in *Quadrans vetus*. It is improbable that such a tradition of style and format could become so strong that one would find the duplication that exists in these two documents.

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[111] *Libros* . . ., 3: 298–299.

[112] Cf. infra, pp. 31–35.

[113] Ibid.

[114] *Libros* . . ., 3: 305.

[115] Ibid., p. 287, and cf. above, p. xx and n. 47.

[116] *Libros* . . . , 3: xl–xli.

[117] Regarding the Arabic origin of the material, the sources of the *Libros* were Arabic by design. The king's purpose was to bring all available Arabic scientific contributions into Spanish, and the exceptional use of a Latin source would surely have been noted. *Libros* . . ., 1: iv.

The second document apparently used in the compilation of *Quadrans vetus* is the Latin treatise with the incipit *Geometrie due sunt partes principales*, an anonymous work mentioned earlier. The addition of the word *principales* is the only difference between this incipit and that of *Quadrans vetus*; thus the writings are frequently confused in manuscript catalogs. Although there are some dozen copies and several fragments of this treatise available, there has been no edition produced other than my rendition, included in this volume. The earliest available manuscripts of each treatise are from the thirteenth century. On the basis of these dates, no judgment could be drawn as to which is older. Yet other evidence points to *Geometrie due sunt partes principales* as being the source and *Quadrans vetus* the adaptation. *Geometrie due sunt partes principales* and the *Libros* treatise both contain theoretical material that is omitted in *Quadrans vetus*. There are measurement problems in *Geometrie due sunt partes principales* that are solved more awkwardly and less accurately than those found in *Quadrans vetus*. And there are directions for the construction of only the shadow square in *Geometrie due sunt partes principales*. None of these factors alone would justify assuming *Geometrie due sunt partes principales* to be the older treatise, but taken together they make rather strong evidence for the case.

Stephen K. Victor uses other arguments to show that *Quadrans vetus* is derived in part from *Geometrie due sunt partes principales*. He discusses the development of the two divisions of practical geometry into artificial and inartificial. As he states, the distinction between the two is elaborated by the author of *Geometrie due sunt partes principales*. Then he points out that Johannes Anglicus, the author of *Quadrans vetus*, uses only one branch of this newly developed division, artificial measurement. He concludes that Johannes obviously would not have omitted one of the two branches in his discussion if he had invented the term.[120] Dr. Victor's conclusion that Johannes Anglicus was taking what he needed from an earlier, established division is further evidence for the dependence of *Quadrans vetus* on *Geometrie due sunt partes principales* rather than vice versa, as Tannery had held earlier.[121]

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[118] Millás, "Introducción del cuadrante," pp.218–258.

[119] G. J. Toomer, personal letter dated November 23, 1969.

[120] *Practical Geometry in the High Middle Ages*: *Artis Cuiuslibet Consummatio and the Pratike de Geometrie*, ed. with translation and commentary by Stephen K. Victor, *Memoirs of the American Philosophical Society* 134 (Philadelphia, 1979): 23. The editions of *Quadrans vetus* and *Geometrie due sunt partes principales* by Nan L. Britt that Dr. Victor cites are portions of my dissertation produced under my former name.

The parallel of content between *Geometrie due sunt partes principales* and *Quadrans vetus* is most apparent in the last section of the latter document in the discussions concerning measurements without the quadrant. Yet, the beginning of the two documents is also very similar. The introductory statements present the study of geometry as having two major divisions, theoretical and practical, as shown earlier. Both deal with the applied aspect and subdivide that into the three areas of altimetry, planimetry and steriometry. At this point, however, *Geometrie due sunt partes principales* departs and gives a lengthy discussion of the principles involved in ratio and proportion. This is offered as the theoretical basis on which the problems of the treatise will be solved. *Quadrans vetus* omits this, as it does other theoretical discussions found later in *Geometrie due sunt partes principales* and the *Libros*. From this point, *Quadrans vetus* begins following the *Libros* in the construction of the quadrant. Once most of the content of the *Libros* has been covered, *Quadrans vetus* returns to material similar to that in *Geometrie due sunt partes principales*. The parallel is not as close as that found in the *Libros*, but the contents are similar enough to merit study.

The material that seems to be borrowed from *Geometrie due sunt partes principales* concerns measurements of the kind usually taken by the quadrant. Yet in this case they are performed with rods, mirrors and shadows; they are nearly all based on the use of similar triangles. This material is interspersed in *Quadrans vetus* with directions for solving the same problems by use of the quadrant. Examples of this parallel material are to be found from paragraph sixty forward: "Si autem non habeas quadrantem et velis mensurare altitudinem. . . ." The first case is the measurement of some tall object, as a tower, by the erection of a rod perpendicular to the ground and the observation of similar triangles. There follow procedures for acquiring the same information through the use of the mirror and the shadow. In most of these cases, *Geometrie due sunt partes principales* is longer and includes some discourse on the mathematical theory behind the procedures. Then both documents discuss determination of the length of horizontal planes by the same tools and, following this, measurements of length and width of both circular and angular planes.

At this point, *Geometrie due sunt partes principales* includes a rather lengthy section not found in *Quadrans vetus*. It concerns the measurement of depths of pits and of inaccessible heights by a system of two rods, two stations, and some rather complicated operations involving proportion. It seems logical that this would have been omitted by the author of *Quadrans vetus* since these methods are far more cumbersome and less accurate than the solution of the same problems by means of the quadrant. The more accurate methods offered in the quadrant section of *Quadrans vetus* are parallel to those in the *Libros*. At this point, paragraph seventeen, the author of *Geometrie due sunt partes principales* introduces his only instrument, the shadow square, a device that appears on the old quadrant also. The instructions for its construction are brief and include marking off the twelve fingers on either side with sixty points, if possible, within each finger. It includes two sighting tables, in the same position as those in the old quadrant, and an alidade in the form of a ruler rather than a thread or plumbline. The instrument is here called *gnomonis instrumentum*, the dial instrument. Usually the term "gnomon" refers to sun dial, but from the description and context it means here simply a dial. There are no instructions in the document for telling time. In fact, the problems discussed with this instrument are the same ones offered in *Quadrans vetus* for the shadow square of the old quadrant. According to Tannery, the shadow square was known in the Arab world some two centuries before the thirteenth.[122] Actually, the square is included as a part of the dorsal side of the astrolabe described in Gunther's version of Messahala's eighth-century treatise.[123] If this material were an interpolation, as Millás maintains, Tannery would still probably be correct in his assumption that it was known as a separate instrument before 1100. In a more recent work on the astrolabe, Ron B. Thomson argues that the construction part of Messahala's treatise is authentic; Thomson's argument thus dates the shadow square as early as circa 800.[124]

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[121] Tannery, "Traité," p. 147.

The remainder of both *Geometrie due sunt partes principales* and *Quadrans vetus* is a discourse on measurements of squared surfaces and of volumes of three-dimensional objects. The two treatises are not parallel in this section, but they do include much similar material. Eight of the last ten paragraphs of *Quadrans vetus* are independent of both *Geometrie due sunt partes principales* and the *Libros*. In some cases the problems are the same as those given in the two presumed sources, but the methods of solution differ. Most of these materials appear in yet another source, an earlier *Practica geometrie* with the incipit *Artis cuiuslibet consummatio* . . . , edited with a translation and commentary by Stephen K. Victor. This work is securely dated internally as 1193.[125] A possible relationship between *Quadrans vetus* and *Artis cuiuslibet consummatio* has been discussed by Dr. Victor and by Professor Marshall Clagett. Professor Clagett showed a strong terminological relationship between the two treatises in the third volume of his *Archimedes in the Middle Ages*. He pointed out specifically the formulas for the relationship of circumference to diameter, the area of a circle, the volume of a cylinder, and the volume of a truncated cone (an incorrect formula, as he states).[126] Dr. Victor draws parallels in two of these cases and in a number of other formulas in this section as well. It should be noted that Dr. Victor maintains that the *Quadrans vetus* is the older of the two treatises and serves as a source of *Artis cuiuslibet consummatio*. However, he offers no specific arguments to support this.[127] Professor Clagett accepts the date of *Quadrans vetus* as probably in the 1270's, well after the secure date of 1193 for the writing of *Artis cuiuslibet consummatio*.[128]

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[122] Ibid.

[123] Gunther, *Early Science in Oxford . . .*, 2: 198.

[124] Ron B. Thomson, *Jordanus de Namore*, pp. 54–56.

[125] *Practical Geometry . . .*, p. 24.

[126] Marshall Clagett, *Archimedes*, 3: 217.

Comparisons of the texts of *Quadrans vetus* and *Artis cuiuslibet consummatio* made by Dr. Victor and myself show the following. The section of *Quadrans vetus* that does not appear in either the *Libros* treatise or *Geometrie due sunt partes principales*, its two presumed primary sources, includes paragraphs 64–65 and 69, all dealing with planimetry, and paragraphs 77–87, all dealing with cubic measurements and volumes. Paragraphs 64–65 deal with measurement of length by use of the quadrant. In this *Quadrans vetus* is similar to *Artis cuiuslibet consummatio* but probably not taken from it; the method of procedure is different. Paragraph 69, on the area of a circle, is almost identical to the rendering in *Artis cuiuslibet consummatio*, found in I, 22.[129] The material in *Quadrans vetus* on depth measure and volume capacity includes paragraphs 77–87. The directions for measuring the depth of a pit follow the same formula in both treatises, but *Artis cuiuslibet consummatio*, II, 34, renders it more fully and in enough different vocabulary that I do not believe it is the source of *Quadrans vetus*. The same kind of variation occurs in *Quadrans vetus*, paragraph 79, although the *Quadrans vetus* rendition could be a summary of the discussion in *Artis cuiuslibet consummatio*, II, 35.[130]

With such striking similarities between *Quadrans vetus*, the *Libros* treatise and the *Geometrie due sunt partes principales*, it seems reasonable to assume the use of the last two in the compilation of the first. The additional use of material shared by and perhaps taken from *Artis cuiuslibet consummatio* seems to complete the picture of the origin of the treatise. Yet there is one notable departure in *Quadrans vetus* from the two major sources that must be considered: the omission of a theoretical foundation for the various operations. Both of the sources include much of this, explaining the general principles to be followed and the reasons why certain procedures work. In omitting such fundamentals, the author of *Quadrans vetus* perhaps lessened the value of his work as a mathematical textbook, which seems to have been the chief purpose of the text. Yet the work fits the general classification of a practical geometry as this genre of literature has been defined recently by Stephen K. Victor. Dr. Victor states:

> . . . Instruction in using instruments and performing computations is probably the defining characteristic of a practical geometry; instruments and computation

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[127] *Practical Geometry* . . ., pp. 329–353 and 24.

[128] Clagett, *Archimedes*, 3: 217.

[129] *Practical Geometry*, p. 176.

[130] Ibid., pp. 310, 312, and 314.

are essential to *Quadrans vetus* as well. Thus Johannes Anglicus' treatise is a practical geometry and perhaps the most widely diffused of them all.[131]

Accepting the work, then, as a typical practical geometry of its day, one can readily understand the absence of theoretical discussions that were available to the compiler in his primary sources. If his purpose was that which we assume, he simply did not need them.

It should also be said of the compiler of *Quadrans vetus* that his material is usually written in a simple fashion, and it is expressed with more clarity than that of either of his two major sources. When the two earlier writers get into a complexity of detail, he summarizes and gives the simplest possible procedure for the operation being described. One adverse result is that in many instances his instructions can be used only for solving the particular problem described. In the other treatises, principles frequently appear which can be applied to other various problems. Still, the organization of *Quadrans vetus,* particularly in the section on construction, is more logical than that of the *Libros;* it moves from the simplest to the most difficult task. (The one exception is that the *Libros* sensibly adds the perpendicular sighting tables last.) In the usage section also, the order is logical and simple. Following the general outline of altimetry, planimetry, and steriometry, the compiler moves through sets of problems to be solved, using first the quadrant with the cursor, then the instrument without a cursor, and finally other tools, as rod, mirror, and shadow. The inclusion of volume measures in the end completes the third division of steriometry.

In relating the three treatises, I have narrowed the dating of *Quadrans vetus* to the years 1277–1284. One view opposing my dating has been discussed earlier but should be mentioned again here. Professor Emmanuel Poulle has stated that he holds this treatise to be a work of the mid-twelfth century.[132] However, he does not address the relationship of the three texts I have discussed. He bases his argument on his belief that a knowledge of the principal contents was available in Europe by the mid-twelfth century. However, Professor Poulle mentions no manuscripts of *Quadrans vetus* earlier than those thirteenth-century copies I have studied. I agree that the instrument preceded our text and that there was a developing literary tradition for the text by the middle of the twelfth century. By the middle of the thirteenth century we have the rather sketchy treatise on the instrument by Johannes Sacrobosco, who died by 1256. In addition, Professor Poulle's dating of *Quadrans vetus* would rule out the possibility that the *Quadrans vetus* was derived from the *Libros* treatise. I have shown earlier that the arguments are strong for the latter being the case.

In conclusion, it seems that the supposed author of *Quadrans vetus* was in fact a compiler. He apparently knew the *Libros* work and leaned heavily on Rabiçag's original contribution to it, in the first section. He used the

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[131] Ibid., p. 24.

[132] Emmanuel Poulle, "Les instruments astronomiques de l'Occident latin . . .," p. 36; cf. above, p. xvii.

Geometrie due sunt partes principales as a complement to the *Libros* work and derived some material from either the *Artis cuiuslibet consummatio* or another source or sources similar to it. He put his materials together in good order, made some additions in appropriate places, and wrote his compilation in a simple, readable and concise manner. The wide distribution of his practical geometry over the next three centuries seems an appropriate reward for a task well done.

C. Analysis of *Quadrans vetus*

Quadrans vetus, as shown in the previous section, is a compilation of materials from at least two and perhaps three earlier sources: *Geometrie due sunt partes principales* (called Gdspp), the treatise on the old quadrant included in the *Libros del Saber* (called LS), and *Artis cuiuslibet consummatio* (called ACC). In the following analysis of the contents of the treatise, the sections that were taken from each of these sources are indicated below in parentheses for the convenience of the reader.

Diagrams of the old quadrant, both complete and in stages of development, appear in most of the manuscripts. An early example from a Princeton University manuscript appears in the illustration on page xlii, figure 2, and a composite drawing of the instrument taken from various manuscript illustrations is shown in figure 3. Drawings illustrating the uses of the quadrant appear in many of the manuscripts, and a particularly fine group of examples from the Princeton manuscript mentioned above appears in figures 4 and 5. Composite drawings, taken from the manuscripts, appear at appropriate places in the following pages.[133]

The author of the tract on the quadrant opens his treatise with a discussion of the divisions of geometry. He separates the discipline into two general categories: theory and practice. Theoretical is that which deals with the contemplation of quantities, proportions and measurements; practical is the application of these principles to particular problems by experiment. It is solely with the latter that he deals in this document. Within the practical he describes three categories; altimetry, planimetry, and steriometry. Of these altimetry deals with the measure of heights, planimetry concerns length and square measure, and steriometry concerns volume. With this brief introduction to the general study the author sets the course for the treatise. He will instruct the reader on how to construct the quadrant, an instrument useful in practical geometry, and then on

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[133] Princeton University Library, Robert Garrett ms 99, f. 165r is figure 2; the composite drawing, figure 3, was made by David M. Sutherland. The series of drawings for *Quadrans vetus* are taken from British Library, Royal ms 12 C IX (*l*), and Bibliotheca Apostolica Vaticana, Barberini ms 276 (*s*). Those for *Geometrie due sunt partes principales* are from Bibliotheca Apostolica Vaticana, Regina Sueviae ms 1261 (*N*) and Oxford, Bodleian Library, Digby ms 147 (*E*).

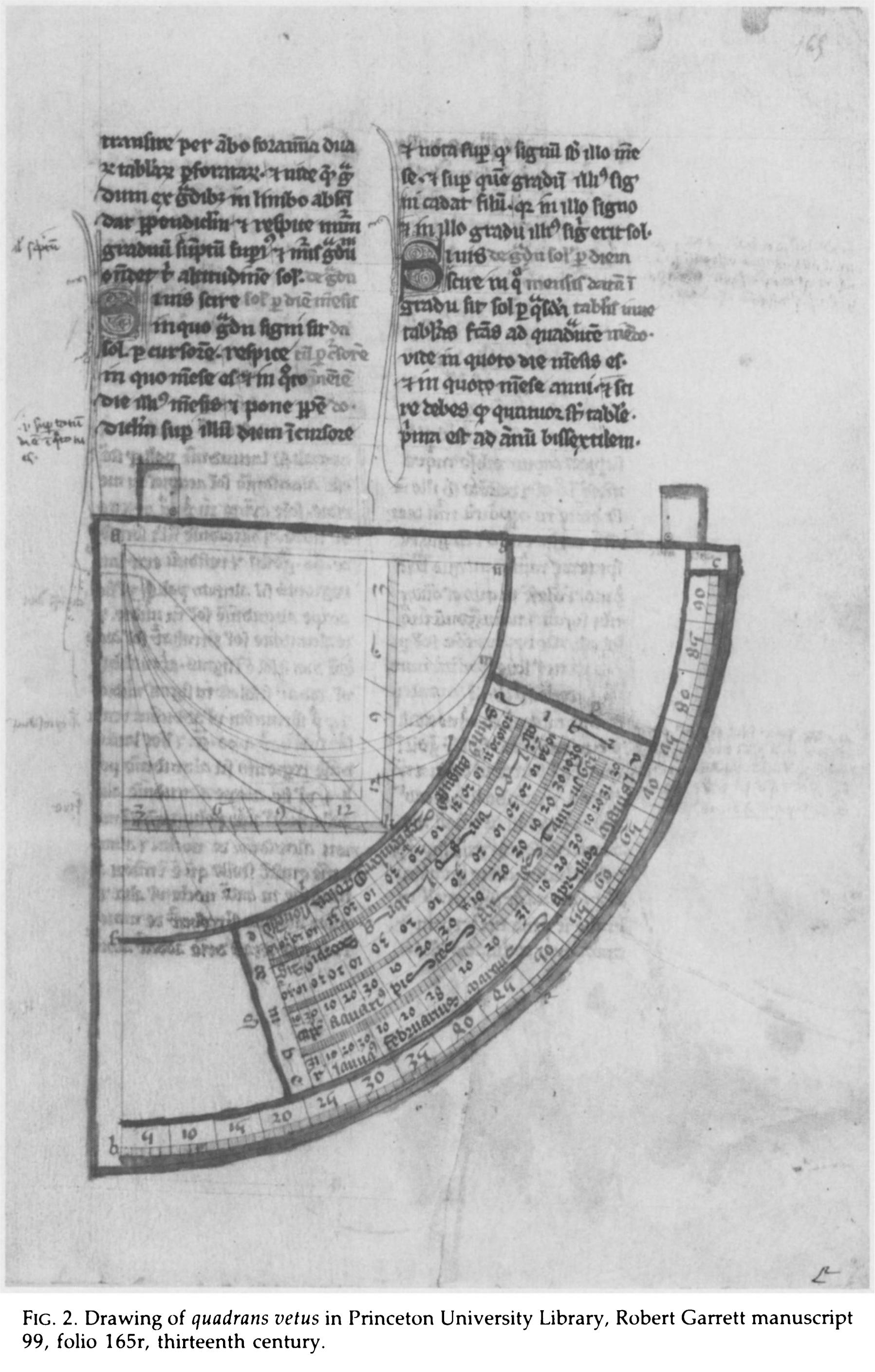

FIG. 2. Drawing of *quadrans vetus* in Princeton University Library, Robert Garrett manuscript 99, folio 165r, thirteenth century.

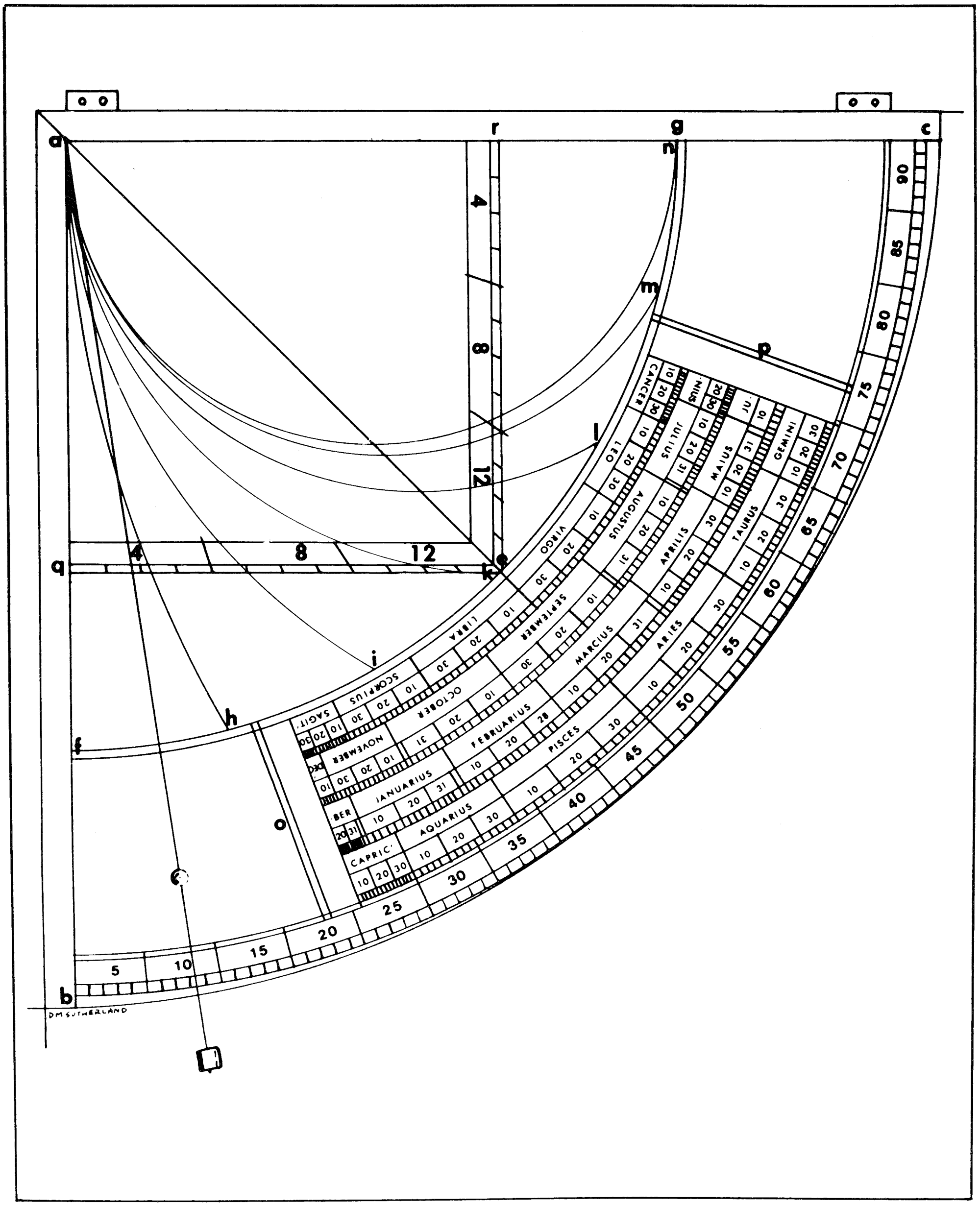

FIG. 3. Diagram of *quadrans vetus,* based on illustrations in the manuscripts used in this edition.

how to use the instrument in solving practical problems. (Paragraphs 1–2 of the Latin text; paragraphs 1–2 of Gdspp.)

The quadrant is defined as an instrument containing a fourth part of a circle in which are inscribed certain lines. The writer maintains that by using it, one can determine the degree of the sun and its declination and

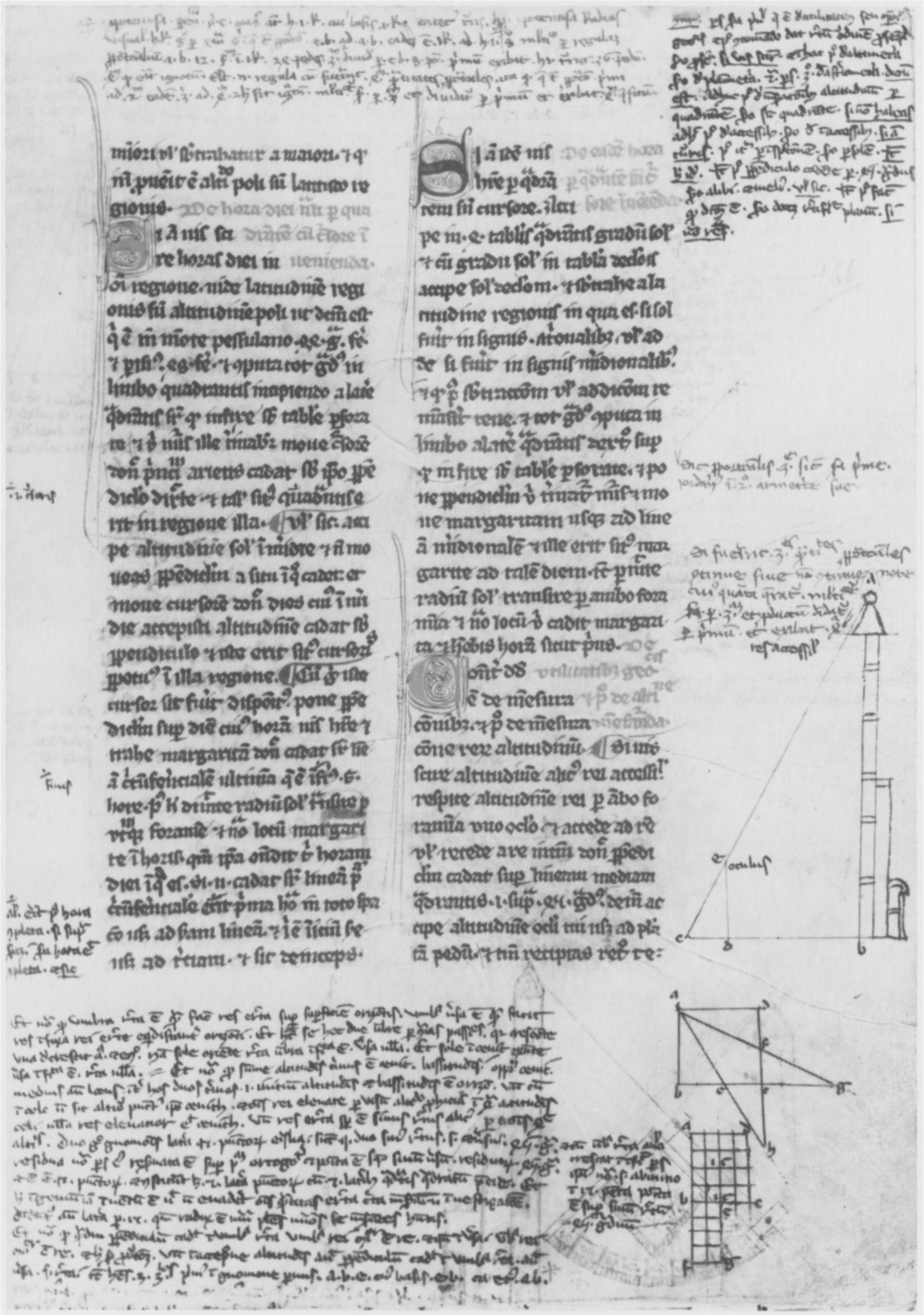

FIG. 4. Drawings illustrating the use of the quadrant, in Princeton University Library, Robert Garrett manuscript 99, folio 166r, thirteenth century.

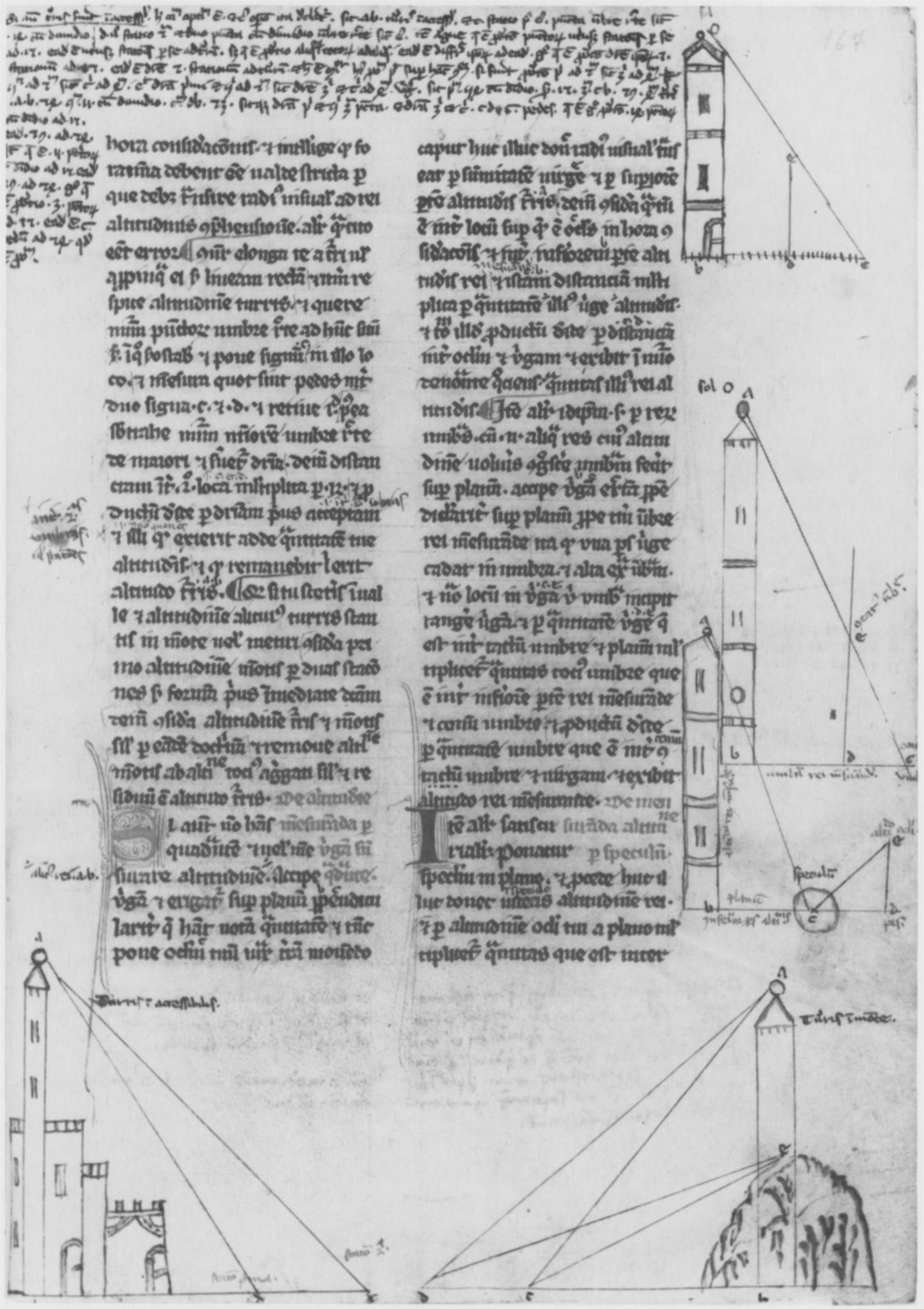

FIG. 5. Drawings illustrating the use of the quadrant, in Princeton University Library, Robert Garrett manuscript 99, folio 167r, thirteenth century.

the altitudes of stars. He can also discern the hour of the day and discover heights of objects, distances of lands, the measurements of plots of land, and the depths of pits. (Text, paragraph 3; not in either source.)

Following these introductory remarks the author gives a description of the procedure for making the instrument as follows. Make the quadrant from a flat surface of bronze, wood, or brass, cut to make a fourth part of a circle. When the approximate form is thus prepared, draw lines just inside the sides of the quadrant to form an exact right angle from the center of the circle (lines *ab* and *ac* in figure 3). Then on the curved border of the plane mark off the enclosed ninety degrees (arc *bc*) and label them in a scale, usually of five degree intervals; this border is called the limbus. Following this, add two small sighting tables on the right side of the quadrant (side *ac*); each table should contain a small hole through which one could sight an object when the quadrant is held with the apex opposite the eye. Approximately one-third of the way toward the apex, draw another arc (*fg*) using the apex as its center. Cut this line into six equal parts (*h, i, k, l, m, n*). Using the division points of these parts, draw six arcs each from the apex of the quadrant to one of the points. (This is done by placing one foot of a compass on some point of line *ac* or an extension of it.) The lines thus formed are the hour lines, through which one can take the unequal hours of the day. (Text, paragraphs 4–10; LS, chapters I–III and XVI.)

When this is completed, construct the cursor, a movable arc-shaped plate (*op*) that is to be placed in a depressed slot above the limbus and the degree scale. This plate should be forty-eight degrees long and about one-third the width of the quadrant. Divide the width of the cursor into four sections, two each for the scales of the months and of the zodiac. Mark the scale of the zodiac on the lowest and uppermost divisions of the cursor, beginning with Aries (the beginning of the zodiac year) in the middle of the lowest section. This must be done accurately, allowing enough space in each sign of the zodiac to correspond to the degree of the declination of the sun in that sign, as measured on the limbus scale below. For example, Aries begins at the midpoint of the degree scale, forty-five degrees, and continues to the right for eleven and one-half degrees. Following this, fill in the two intermediate spaces in the cursor with indications of each month and its days, beginning by placing January 1 in the space above Capricorn which corresponds to that day. (With these instructions the author includes a small chart which gives the position of the sun in the zodiac belt on the first day of each month; this information is necessary for collating the zodiac and monthly calendars on the cursor). (Text, paragraphs 11–29; LS, chapters III–IV).

In the remaining portion of the quadrant make a shadow square by extending a line from a point in the center line (*ak*) above the cursor out to each side of the quadrant (*kq* and *kr*). Then draw two sets of parallel lines inside the new sides to produce a double border. Within the border mark off twelve equal parts per side and number them, beginning at the outside edge on either side. Then affix to the apex of the quadrant a plumbline with a sliding bead or pearl on the line. With this the composition of the quadrant is completed. (Text, paragraphs 30–31; LS, chapters VII, V and VIII.)

The author now begins the second half of the treatise, an extensive section on the various uses of the quadrant in solving problems. In some cases he adds methods of solving the same problems without a quadrant. His instructions follow.

The first problem, ascertaining the height of the sun at any hour, is solved by holding the quadrant so that the apex is toward the sun and the lower right corner, point C, toward oneself. Let the ray of the sun fall through both of the holes of the sighting tables and note the degree in the limbus that the plumbline crosses; the number of the degree is the height of the sun. Then, to learn the position of the sun in the zodiac belt (its position that day in its annual east–west movement), press the plumbline against the quadrant in the position that indicates the height of the sun. The place where the plumbline crosses the zodiac calendar shows the position of the sun in the zodiac. (Text, paragraphs 32–34; LS, chapters II and VII.) If, however, you wish to have a more precise measurement of the sun's position in the zodiac, use bissextal tables which are constructed for use with the quadrant; these give the position of the sun in the zodiac by degrees and minutes for each day of each year in the four-year cycle, beginning with leap year. (Such tables frequently are given at the end of the manuscript of *Quadrans vetus*. They are usually followed by a table showing the degrees of declination of the sun (its position in its north–south movement) when it is in each degree of each sign of the zodiac. Similar tables follow some manuscript copies of the treatise on the quadrant by Campanus of Novara. Figures 6–9 are examples of bissextal tables, and figure 10 is an example of a table of solar declination.[134]) (Text, paragraphs 35–38; not in either source.)

The next problem discussed is how to determine the declination of the sun. To ascertain this, place the plumbline over the beginning of Aries and then again over the degree of the zodiac in which the sun lies, as determined above; the difference in degrees between these two locations is the declination of the sun for that day. For the same knowledge through the tables, go to the table for the current year in the cycle (figures 6–9), read down its first column to the day of the month, and move across to the column of the current sign and month. Here you find the position of the sun in the zodiac for that day of that year. Turn now to the declination table (figure 10), locate the sign and degree taken from the previous table, and read the degree of declination given in the column on the right; this

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[134] For a discussion of Campanus' treatise on the quadrant, cf. Campanus of Novara, *Campanus of Novara and Medieval Planetary Theory: Theorica planetarum*, edited by Francis S. Benjamin, Jr., and G. J. Toomer (Madison, 1971), p. 15. Figures 6–10 are taken from Princeton University Library, Robert Garrett manuscript 99, ff. 168v–170v, 13c.

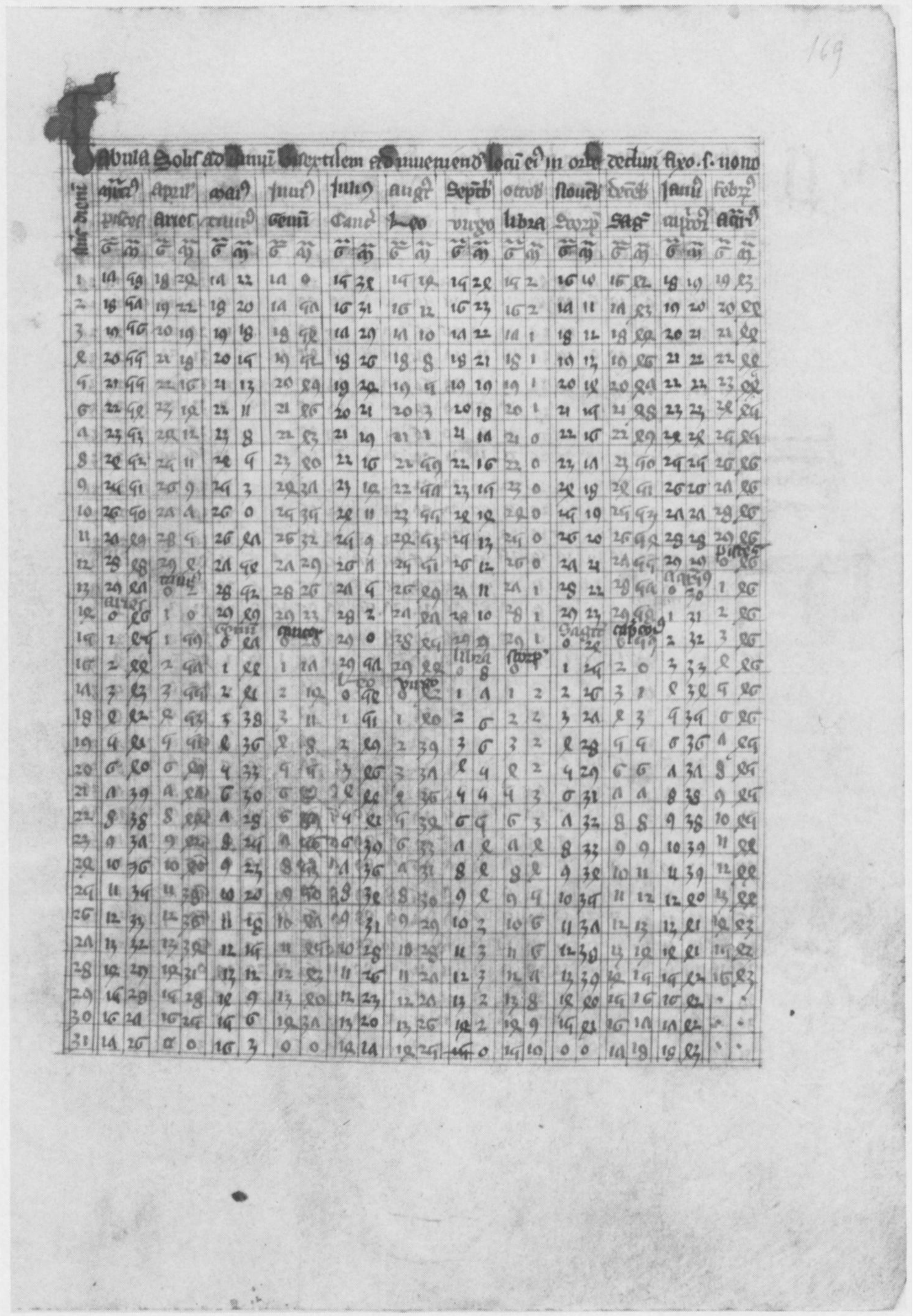

FIG. 6. Table of the bissextal year, in Princeton University Library, Robert Garrett manuscript 99, folio 169r, thirteenth century.

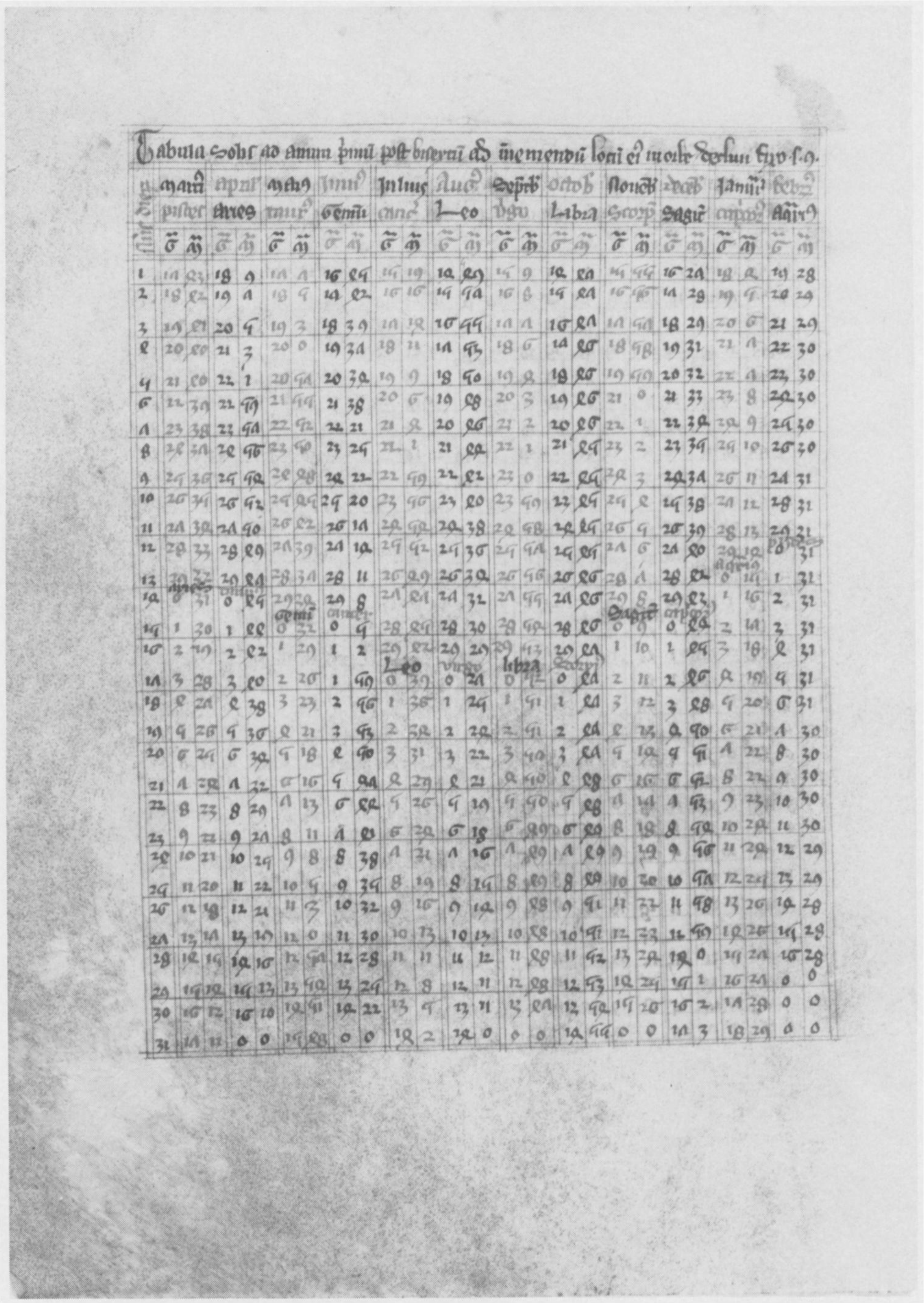

FIG. 7. Table of the first year after the bissextal year, in Princeton University Library, Robert Garrett manuscript 99, folio 169v, thirteenth century.

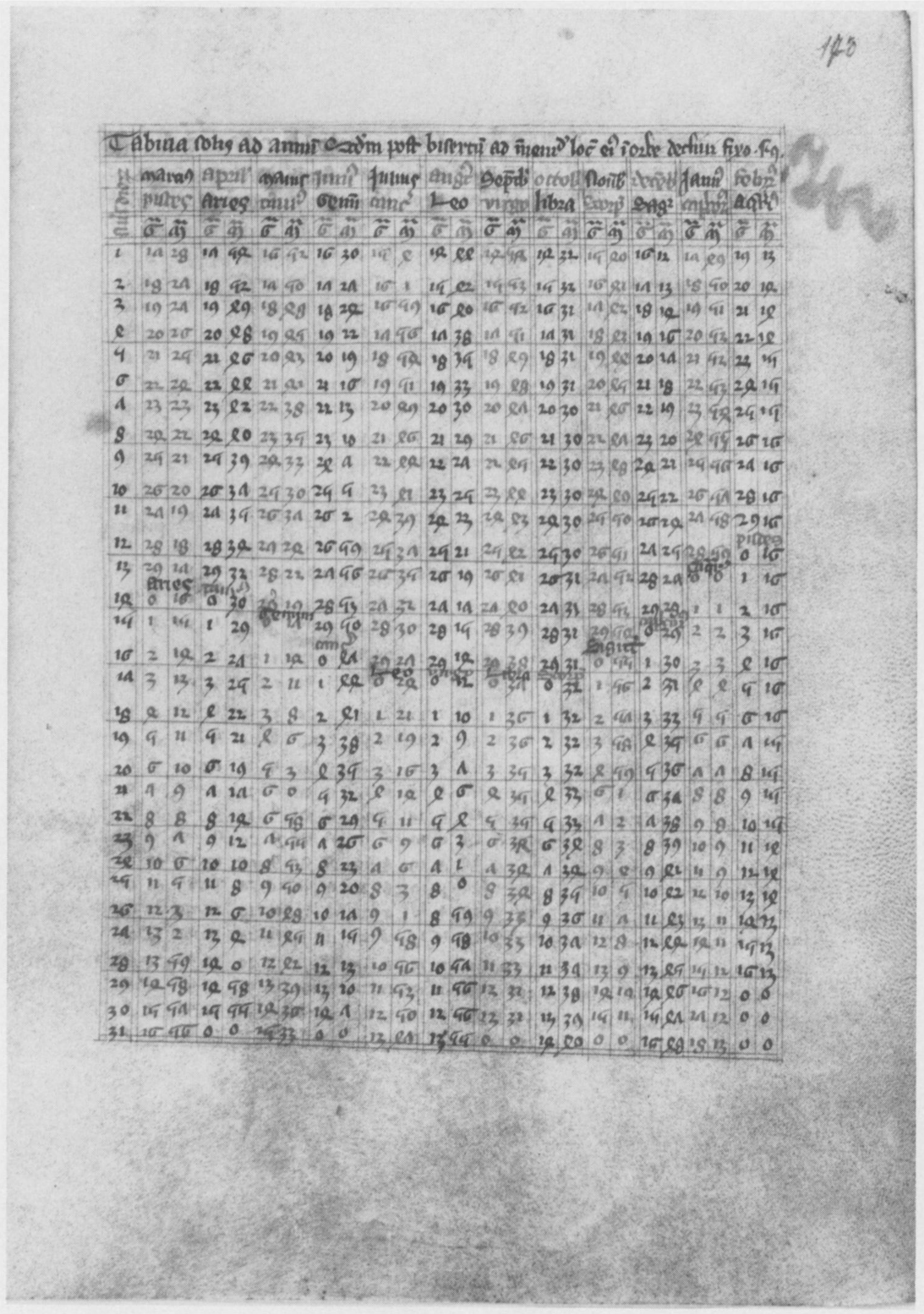

FIG. 8. Table of the second year after the bissextal year, in Princeton University Library, Robert Garrett manuscript 99, folio 170r, thirteenth century.

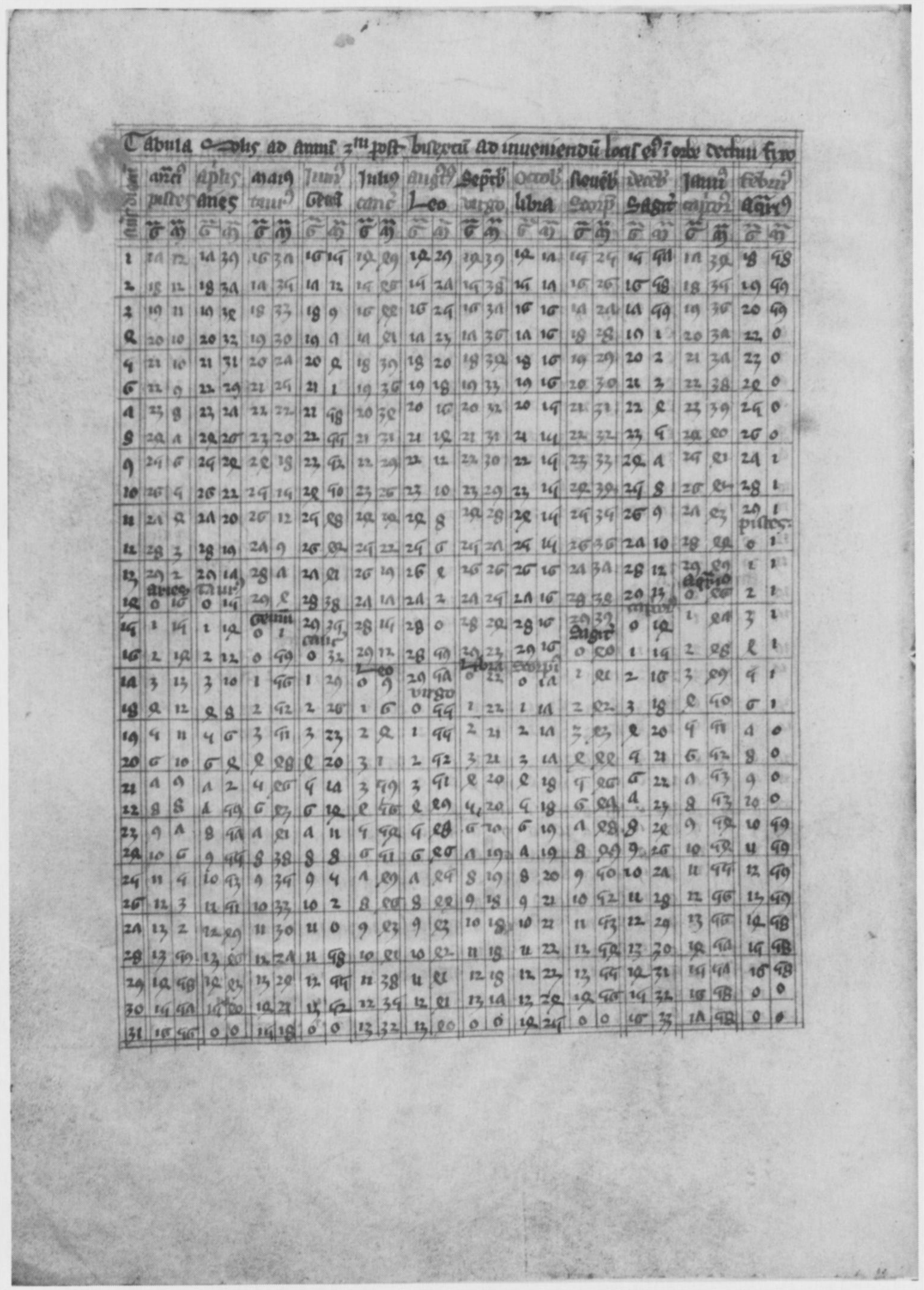

FIG. 9. Table of the third year after the bissextal year, in Princeton University Library, Robert Garrett manuscript 99, folio 170v, thirteenth century.

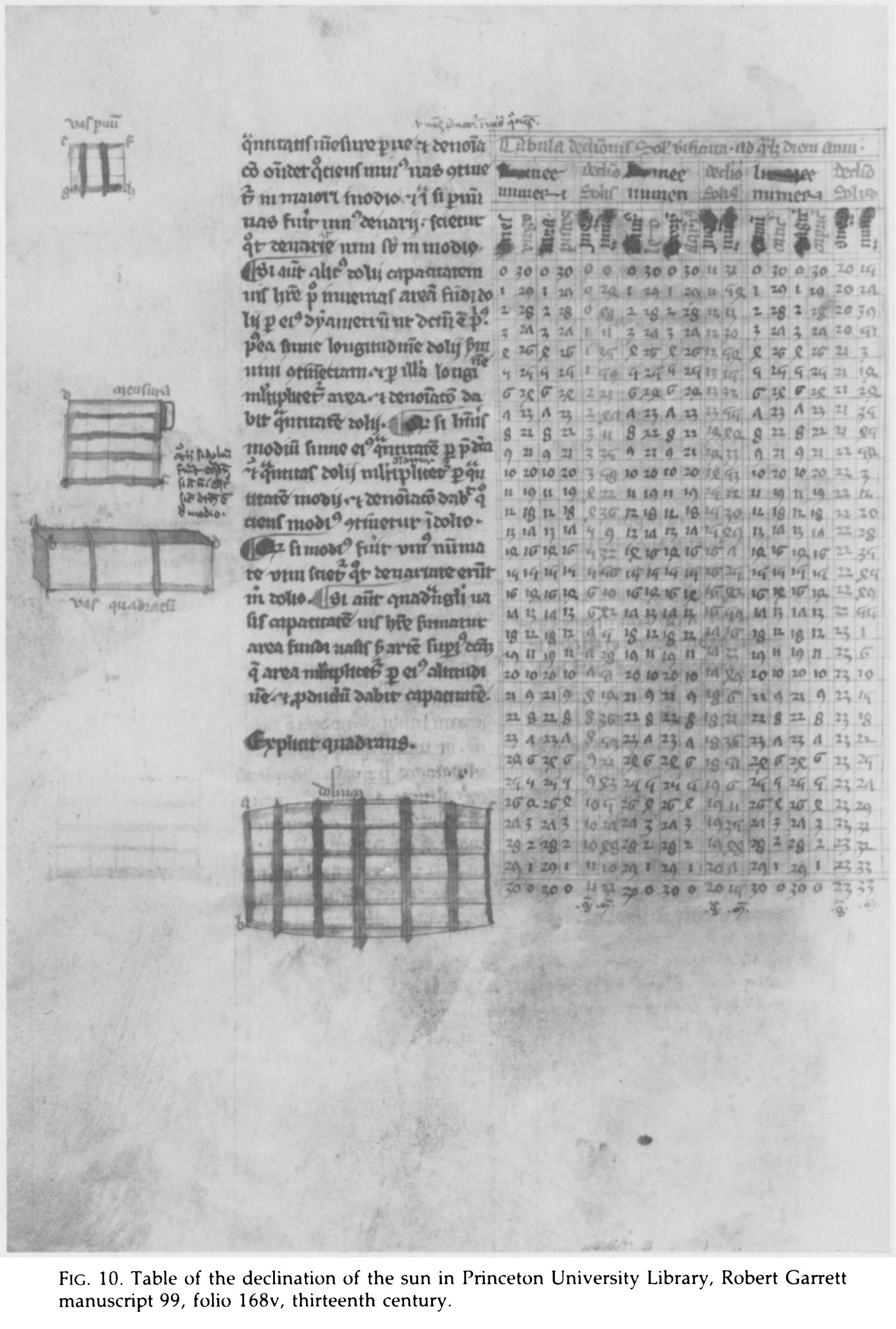

FIG. 10. Table of the declination of the sun in Princeton University Library, Robert Garrett manuscript 99, folio 168v, thirteenth century.

is the declination of the sun for that day. (Text, paragraphs 39–40; LS, chapter VI, covers paragraph 39 but not 40).

The next set of instructions concerns the taking of one's latitude by several methods. The simplest method given is to take the height of the sun at noonday on the first day of Aries or Libra; subtract this amount from ninety degrees, and the remainder will be the latitude of the region. For another method take the altitude of the sun at midday and subtract from this the declination of the sun on the same day if the sun is in a northern sign (Aries, Taurus, Gemini, Cancri, Leo or Virgo). If it is in a southern sign (Libra, Scorpius, Sagittarius, Capricorn, Aquarius, or Pisces), add the declination to the height of the sun. In either case, subtract the result from ninety degrees, and the remainder is the latitude. For a third method take the altitude of a fixed star close to the pole, once when it is at its highest point of the night and again when it is at its lowest point. Subtract the lesser altitude from the greater, take one-half of the difference, and add this to the lesser. The result is the altitude of the pole, or the latitude of the region. (Text, paragraphs 41–43; LS, chapters IX–X and XVIII).

The following set of problems concerns the use of the cursor. To set the cursor for use in a given location, first obtain the latitude of the region as explained above and then mark off that number of degrees in the limbus, counting from right to left. Next move the cursor until the first day of Aries falls directly over the marked degree of the limbus, and this will give the position of the cursor for the region. Another method is to take the altitude of the sun at midday and, holding the plumbline in that position, move the cursor until the mark for that particular day falls under the plumbline. This is just the reverse of the first procedure. Now with the cursor in correct position you can determine the time of day in unequal hours in a given region by using the six hour lines engraved on the face of the quadrant. Place the plumbline on the cursor over the current day and move the sliding bead across the thread until it touches the line of the sixth hour (noon). Then hold the quadrant so that the sun's ray falls through both holes of the sights, letting the plumbline fall free. The bead will then fall over the hour or portion of that hour which is the correct time. (Text, paragraphs 44–46; LS, chapters III–IV.)

If you have a quadrant without a cursor (an earlier but common type of quadrant), you must use the bissextal tables to learn the position of the sun in the zodiac for a given day. With information from these, you can determine the declination of the sun from the declination table. This should then be subtracted from the latitude of the region if the sun be in a northern sign, or added to the latitude if it be in a southern sign. Then take the resulting number and count off that number of degrees in the limbus, from right to left as before. Again, the plumbline is placed over this degree and the bead is moved as before to the midday, or sixth, hour line. Then, just as previously, the sun's ray is allowed to pass through the holes of both sights, with the plumbline falling free. The bead then touches the appropriate hour line on the quadrant on some point between two of these lines. This point indicates the hour of the day or some estimable portion between two hours. (Text, paragraph 47; not in either source.)

There follows a section on the measurement of heights of objects, with the first example being those objects which are in the same plane as the viewer. For this measurement, sight the top of the object, such as a tower, through both viewing holes and, holding this position of the quadrant, move backward or forward until the plumbline falls over the middle line of the quadrant, which is forty-five degrees. Then move backward a length equivalent to your own height, thus forming an isosceles right triangle whose angles are your feet, the base of the tower, and the top of the tower. Then measure the distance between your feet and the base of the object; this distance equals the height of the tower. (See figure 11.) If the tower is on a different plane from you (presumably higher, as on a hill or a wall), sight a point on the tower which is parallel to your eye. (This may require standing on a ladder or climbing a tree, but the author does not mention this.) Check to see that your position is parallel to the chosen point by moving to and fro until you sight the point through both sighting tables while the plumbline falls straight down the left edge of the quadrant. Note this point on the tower and then sight the top of the tower from the same position. After noting the degree of the angle thus formed, measure the distance from your position to the point chosen on the tower. (No mention is made of how one is to accomplish this.) Using these figures (angle-side-angle of a right triangle), calculate the height of that portion of the tower above the chosen point. Then measure the distance from the point to the ground (presumably with a plumbline or other measuring rod), add the two amounts, and you have the height of the tower. (This operation, in paragraph 50, is rather obscure. Nine copies of the sixty-five collated in this edition include marginal notes attempting to clarify the instructions. Figure 12 is offered as an illustration, but it too is unclear. Text, paragraphs 49–50; 49 appears in LS, chapter XIV, but 50 is in neither source.)

The same thing can be accomplished by using the shadow square of the quadrant. Sight the apex of the object to be measured through the two sighting holes of the instrument. Then check the plumbline and determine over which side of the midline it falls. If it falls on the right side, take the number of the point over which it falls; if it falls on the left side, take the number of the point and divide this number into 144. Then measure the distance between yourself and the tower and multiply this amount by twelve. Divide this product by the number of points taken earlier. Add the amount of your own height to the result, and the sum is the height of the tower. (Text, paragraphs 51–52; LS, chapter XIV.)

A third method offered by the author involves the use of shadows. If the sun is in the altitude of 45°, the shadow of any object is equal to the object. However, in any other hour one may use the plumbline and sights as in the above exercise. The proportion of any shadow to its object is the

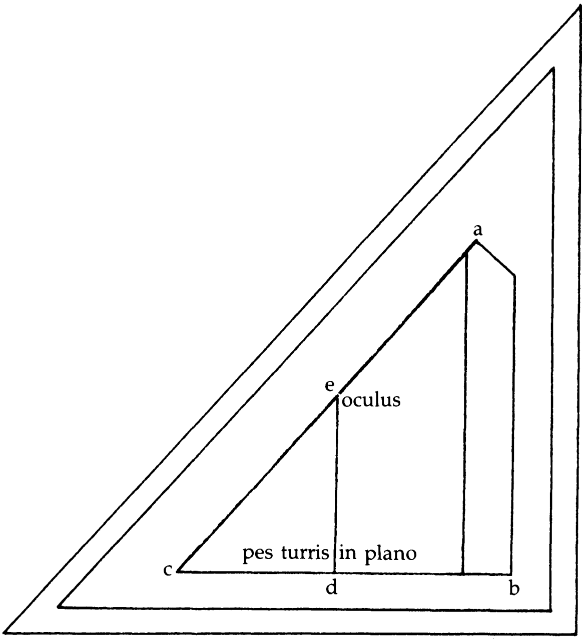

FIG. 11. ms *s*.

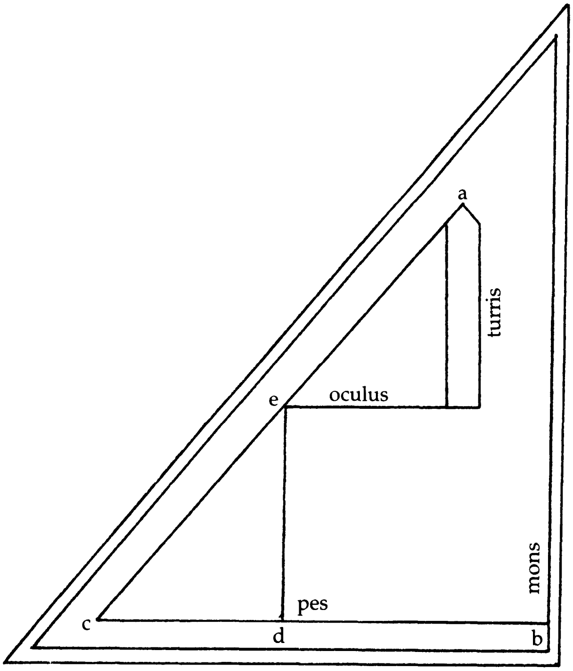

FIG. 12. ms *s*.

same as the proportion of the points in the right side of the shadow box to the number twelve. In case the measurement results in points on the left side, you can convert these points to the right side by dividing the number of points of the left shadow into 144. The result is the number of points of the right shadow. (The author only gives instructions here; he does not attempt to explain the principle involved of tangents and cotangents of angles.) The reverse is also explained: to convert right shadows to the left, divide 144 by the number of points in the right shadow. (Text, paragraphs 53–56; LS, chapters XI–XIII.)

The next exercises concern measuring the heights of inaccessible objects, again using towers as examples. One proceeds by taking two sightings of the apex of the tower, both in a straight line back from the base. In each case, determine the point on the right side of the shadow square where the plumbline falls. (This necessitates being rather close to the base of the tower in order to use the right side. Nothing is said here of using the left side, from farther back, and converting.) Then subtract the lesser point from the greater, measure the distance between the two stations, and multiply this distance by twelve. Then divide the product by the difference between the two points and add your height to the quotient; the resulting sum is the height of the inaccessible tower. (See figure 13. Text, paragraphs 57–58; LS, chapter XIV.)

In another case, one standing in a valley might wish to measure the height of some tower on a mountain. Proceed as above, using the two stations, to take the height of the mountain and then that of the top of the tower. Then subtract that of the mountain from that of the tower, and you have the actual height of the tower. (See figure 14. Text, paragraph 59; not in either source.)

Following this, instructions are offered for measuring without a quadrant, by use of rods, mirrors and shadows. The first, by use of a rod, is the simple construction of two similar triangles. Erect a rod in a given point and find the point behind it where you can see from the ground the apex of both rod and tower. Then multiply your distance from the base of the tower by the height of the rod and divide the product by your distance from the rod; the result is the height of the tower. Or you can use the length of the shadow to construct similar triangles. Again, the result of the procedure is the height of the thing being measured. (See figure 15.) For the same operation with a mirror, place the mirror on the ground so that it reflects the apex of the tower, and place yourself erect in a position to see this reflection. Thus, the mirror assumes the role of the eye and you assume that of the rod in the original exercise; proceed as above, and the result is the height of the tower. (See figure 16. Text, paragraphs 60–63; Gdspp, paragraphs 5–8.)

The author next moves to the second area of measurements: planimetry, or measuring of both length and surface of flat planes. First, for the measurement of a plane lying flat, he instructs one to reverse the procedure of measurement of a height. Hold the quadrant with the apex toward the

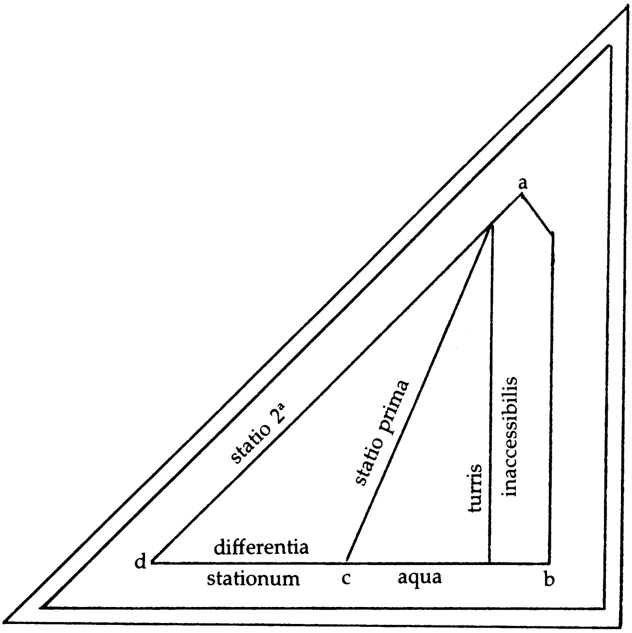

FIG. 13. ms *s*.

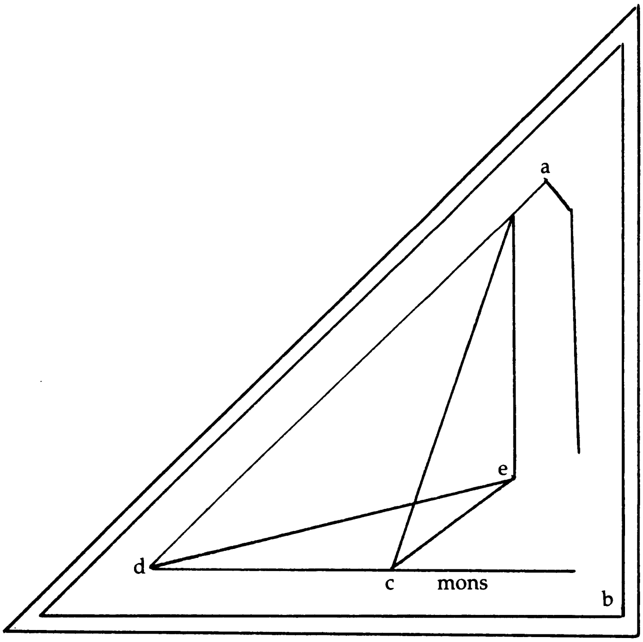

FIG. 14. ms *s*.

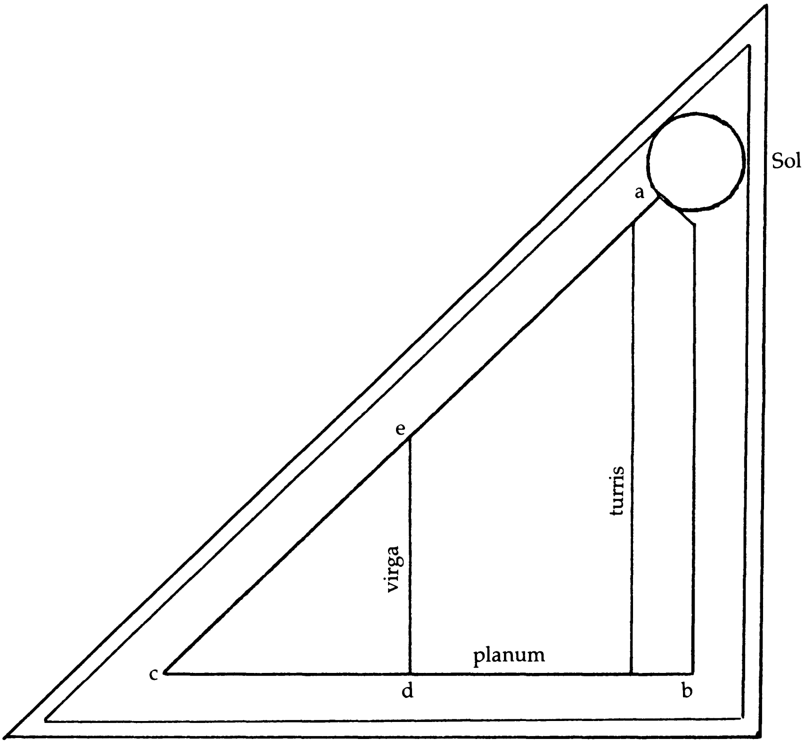

FIG. 15. ms *s*.

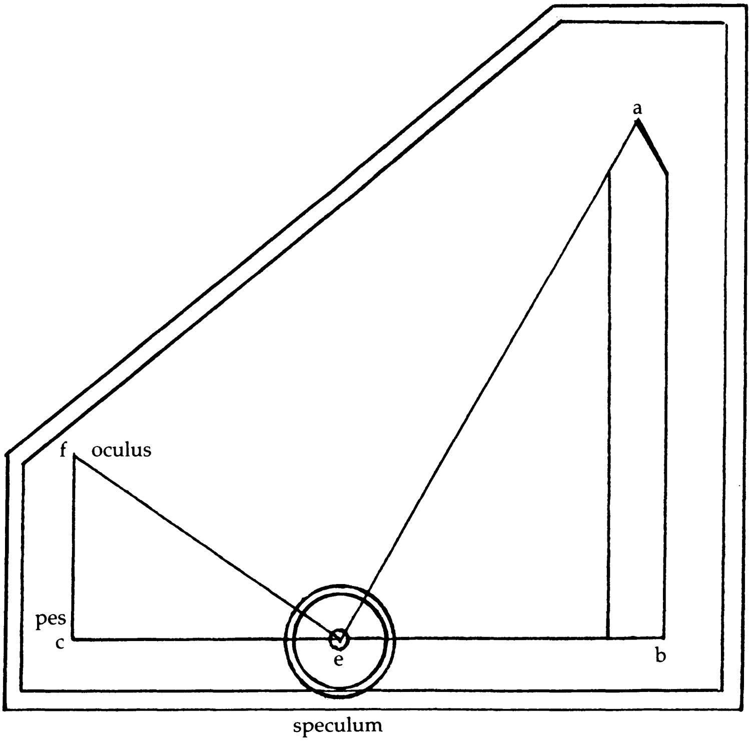

FIG. 16. ms *s*.

eye and the cursor toward the object and sight the end of the object. Then note the number of points marked off in the right shadow by the plumb-line, multiply your height by twelve, and divide the product by the point number; the quotient is the length of the plane. (Text, paragraphs 64–65; in neither source.) The same result may be had by use of rods. Erect a rod perpendicular to the plane and another rod at right angles to the first. Then, standing beside the first rod, sight the end of the plane and note the point at which your line of vision cuts the second rod. By proportion of the known triangle to the unknown, you have the length of the plane. (See figure 17.) For another method, using a mirror, place the mirror on the ground to reflect one end of the plane; place yourself prone, perpendicular to the plane, but in a position to see the reflection. By comparing the proportions of the similar triangles formed, you can deduce the length of the plane. (See figure 18. Text, paragraphs 66–68; Gdspp, paragraphs 9–10.)

The second part of the text on planimetry concerns surface measure, in either circular or angular figures. The area of a circle is obtained by multiplying the radius by half the circumference. The circumference is known by tripling the diameter and adding to it a seventh part. Then the author provides directions for measuring the surface of every kind of triangle. The surfaces of an equilateral triangle, an isosceles, and one of unequal sides are described in detail, all following the formula of the area being equal to one-half of the base times the height. (See figures 19, 20 and 21.) Moving to quadrilaterals, the author gives the formula for the surface of a square, simply multiplying one side by the other. For a quadrangle, multiply the lesser side by the greater. The area of an equilateral pentagon is said to be obtained as follows: square one side (n^2), multiply the product by three ($3n^2$), subtract the value of one side ($3n^2 - n$), and take one-half of the remainder [$(3n^2 - n)/2$]. The result is the area.[135] (See figures 22–24. Text, paragraphs 69–76; Gdspp, paragraphs 22–28; ACC, I, 22 for text paragraph 69.)

Leaving these measurements, the author moves to depths of pits and volumes of vessels. To measure the depth of a pit, sight the bottom of the opposite side of the pit with the quadrant and note the number of points in the right shadow of the quadrant; multiply the diameter of the pit by twelve and divide the result by the number of points of the shadow. The quotient is the depth of the pit. (Text, paragraphs 77–78; LS, chapter XVII.) For the capacity of the same pit, take the depth as measured already and multiply this by the area, which has been determined as given above. The result is the capacity of the pit. (Figure 25 is incomplete and obscure). Similarly, if you wish to know the volume of a column (presumably square), square the breadth of one side and multiply the product by the

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[135] I am indebted to Stephen K. Victor for clarifying this last procedure for me. Further explanation of the formula can be found in M. Folkerts, *"Boethius" Geometrie II* (Wiesbaden, 1970), pp. 101–102.

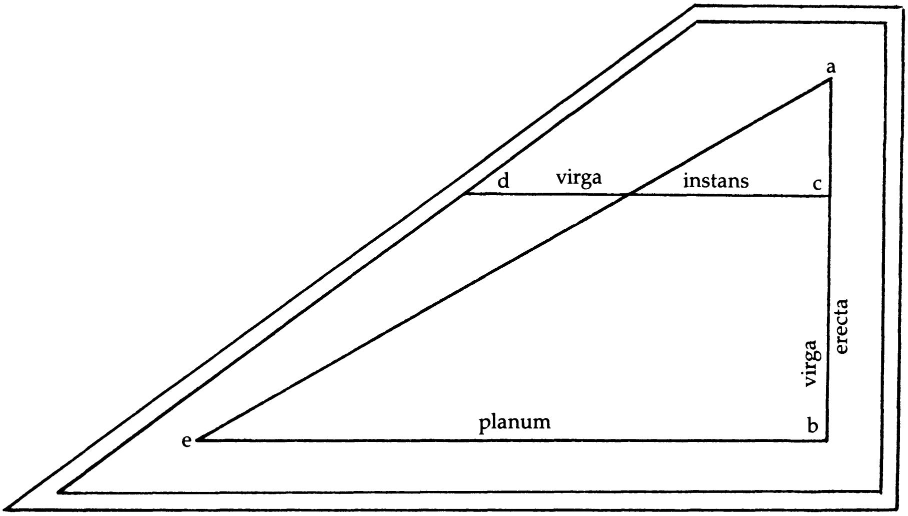

FIG. 17. ms *s*.

height, and the result is the magnitude or volume. (Figure 26 is in error; it illustrates a round column. Text, paragraphs 79–80; in neither major source; possibly paragraph 79 is a summary of ACC, II, 35.)

The last section of the treatise concerns the capacity of certain vessels, the first being the *modius* or bushel, a round container smaller at the base

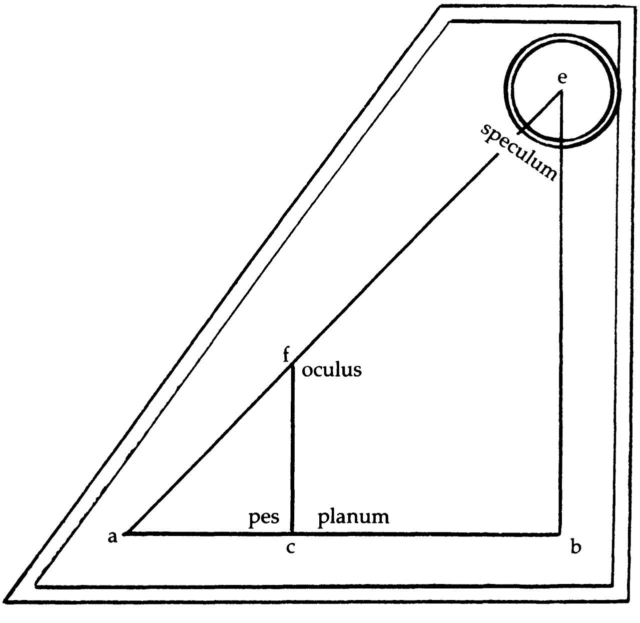

FIG. 18. ms *s*.

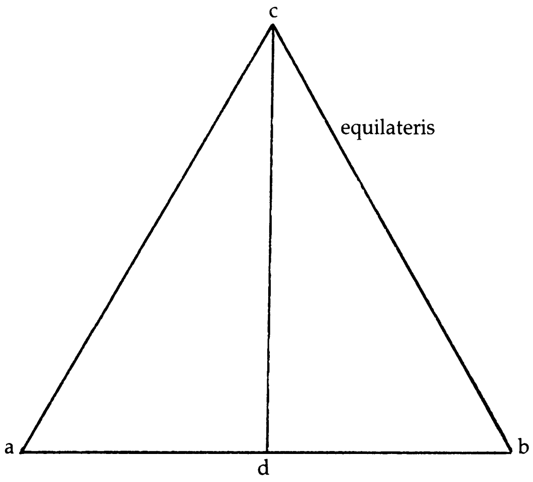

FIG. 19. ms *1*.

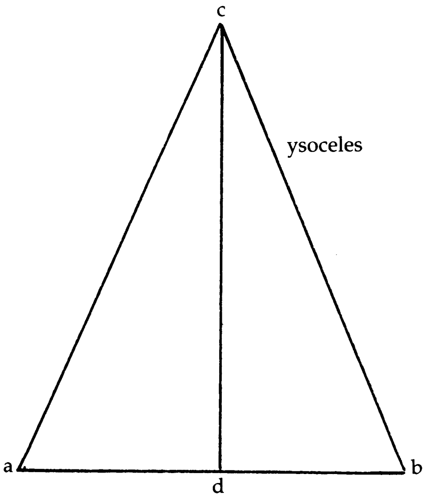

FIG. 20. ms *1*.

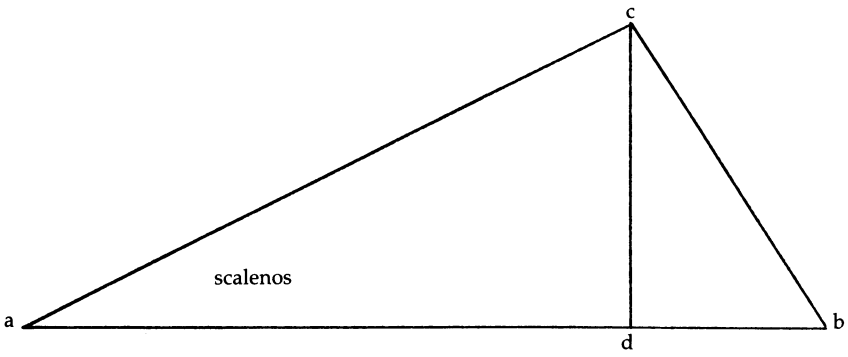

FIG. 21. ms *1*.

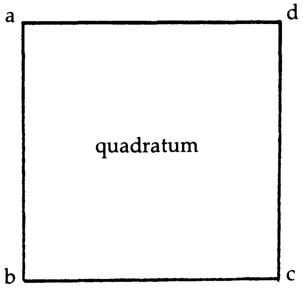

FIG. 22. ms *1*.

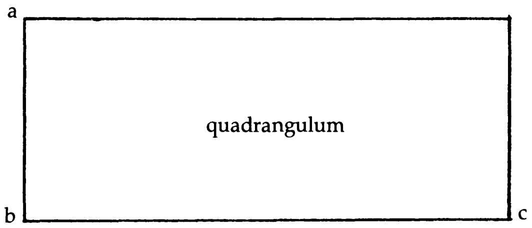

FIG. 23. ms *1*.

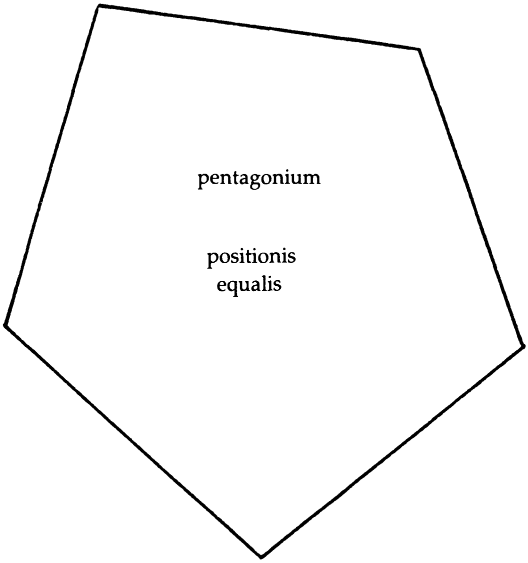

FIG. 24. ms *1*.

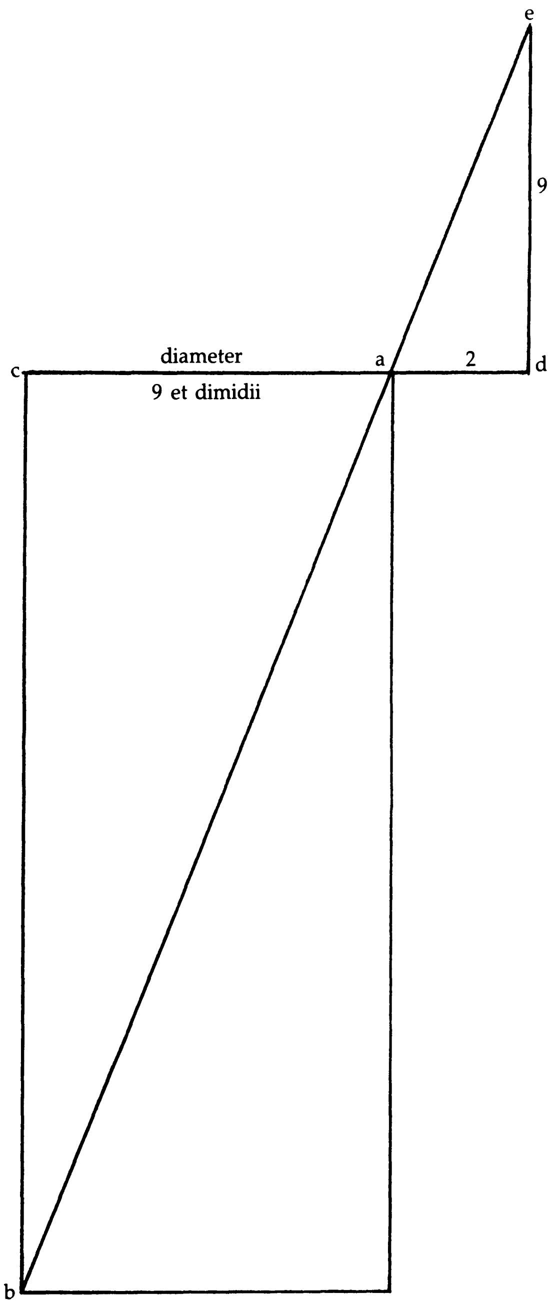

FIG. 25. ms *1*.

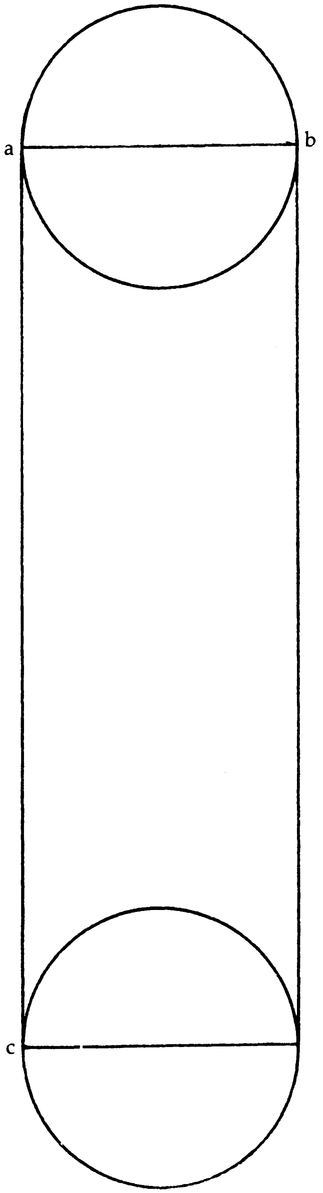

FIG. 26. ms *1*.

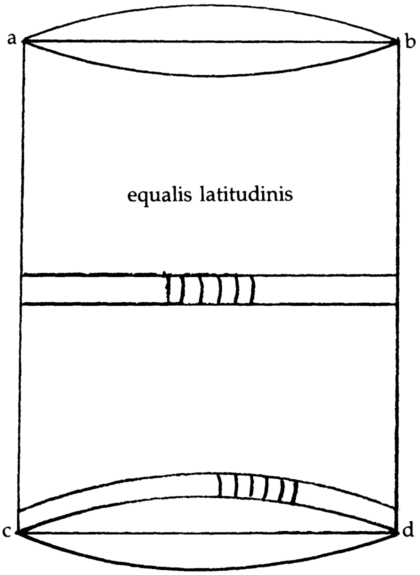

FIG. 27. ms *1*.

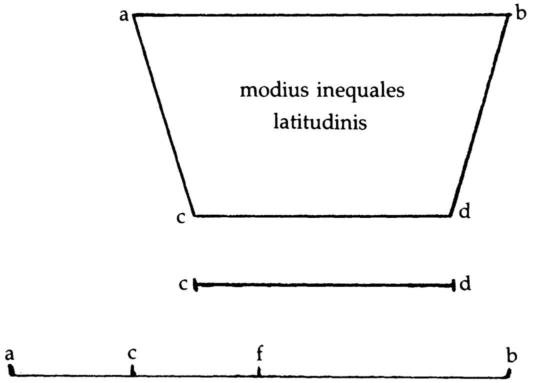

FIG. 28. ms *1*.

than at the top.[136] Take the diameter of both base and top, subtract the lesser from the greater, and add half of the result to the lesser. Then compute the area of this new median base by the aforesaid methods and multiply this by the height of the vessel; the product is the capacity of the bushel. (Figure 27 and 28 are intended to illustrate this but are somewhat inaccurate.) In the case of two vessels, the smaller of known capacity,

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[136] The word *modius* in classical Latin is the modern equivalent of peck, according to C. T. Lewis and Charles Short, *A Latin Dictionary* (Oxford, c. 1869), p. 1155. R. E. Latham, *Revised Medieval Latin Word-List* (London, 1956), p. 302, calls it a bushel, with an estimated measure of eight gallons, in the period A.D. 1086–1399. This latter definition falls within the time period of the work and is thus used.

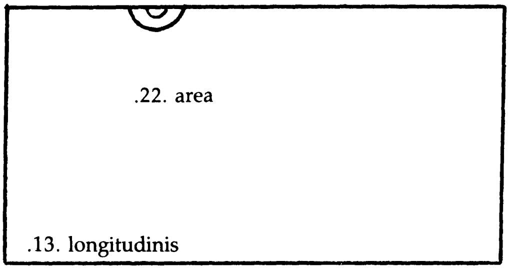

FIG. 29. ms *1*.

measure the larger by the quantity of the smaller, and the result is the number of times that the smaller vessel is contained in the larger. For a large jar with perpendicular sides, determine the area of the base by its diameter and multiply that by the length of the vessel to get the capacity. To know how many bushels the large jar will contain, divide the capacity of the bushel into the capacity of the large jar. If the vessel is quadrangular, take the area of the base by the aforesaid means and multiply this by the height of the vessel; the product will be the capacity. (Figures 29 and 30 are intended to illustrate this last section but are inadequate.) This ends the treatise on the quadrant. (Text, paragraphs 81–87; in neither source.)

D. Analysis of *Geometrie due sunt partes principales*

This treatise begins with the same type of introduction as that in *Quadrans vetus* and with only one difference in its incipit, the addition of the word *principales*. There is the same division of geometry into theory and practice, with theory defined as the study of proportions through mental speculation only and practice as the study of similar proportions to solve problems by means of the senses. The author lists a number of common measures such as the hand, foot, and furlong which are used in practice; these do not appear in *Quadrans vetus*. The author states that the art of measurement is of two types: natural and artificial. The former is the determining of an unknown quantity by use of a known, by some simple mental operation. Artificial, or skilled, measurement is that taken by the use of instruments and numbers. His concern is with the latter type, which he divides into three categories: altimetry, planimetry, and steriometry or cosmimetry. Altimetry is the measure of heights; planimetry concerns

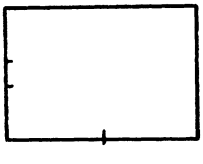

FIG. 30. ms *1*.

lengths and breadths; steriometry or cosmimetry is the measure of volumes and capacities. (Paragraphs 1–2 in the Latin text.)

Thus far, the author roughly parallels the introduction of *Quadrans vetus*, but at this point he departs from it to include a short discussion of ratio and proportion. He gives instructions for finding the ratio of two numbers, whether they be two known quantities, one known and one unknown, one known and a proportion of an unknown, or the square root of a given number. This diversion continues for some thirty-five lines and leads into a discussion of similar triangles and their use in measurement. Thus the author of this treatise gives a theoretical foundation for the procedures he will discuss, in contrast to the author of *Quadrans vetus* who includes only the instructions for solutions of particular problems. (See figure 31. Paragraphs 3–4.)

With the principles of his operations explained, the author begins a series of exercises for the solution of particular problems. The first of the series concerns altimetry, in which he explains how to measure the height of an object in one's own plane by use of a rod. Erect the rod perpendicularly over the plane, sight the top of the rod, and construct similar triangles. From this you can deduce the height of the object by the proportion of the bases of the two triangles. The author gives an example and works out this first problem in detail. (See figure 32.) He then gives a second method, using the shadow of the object to be measured. Erect a rod near the end of the shadow so that the ray of the sun strikes one point on the rod, creating another pair of similar triangles; use the same procedure as above to determine the height of the object. For the third alternative, place a mirror on the ground and move backward, here and there, until you can see the height of the object in the reflection. Then use your distance from the mirror and your own height to form one triangle and the distance from the mirror to the object and the object's height to form the second. Proceed as above with two similar triangles. (See figure 33. Paragraphs 5–8).

The author now moves to measurement of the length of a plane. Erect one rod perpendicular to the plane and another at right angles to the first, and then look from the top of the first rod to the end of the plane and note the point in the second rod that your line of vision crosses. Again you have formed two similar triangles and can proceed as above. (See figure 34.) In like manner you can use a mirror by placing it above the plane in a position where the end of the plane is seen in the reflection. Again use your own height and position to form the second triangle and deduce the length of the plane from the similar triangles. (See figure 35. Paragraphs 9–10.)

Using the same principles, the author discusses the measurement of the depth of a pit. Erect a rod over the edge of the pit and another as a diameter across its mouth. Then sight the opposite point at the bottom of the pit from the top of the erected rod and note where your line of vision cuts the diameter. Using the two similar triangles you have created,

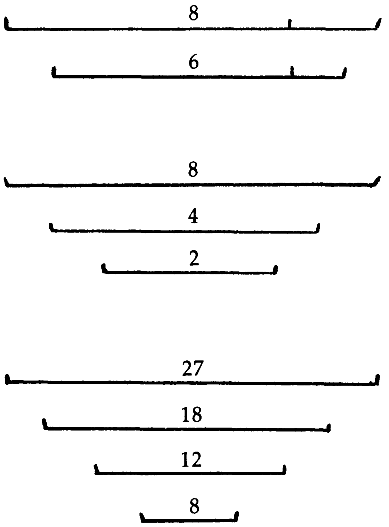

FIG. 31. ms *E*.

deduce the depth of the pit from their proportions. (See figure 36.) For the same with a mirror, place it above the mouth of the pit, in the same position as earlier, so that it reflects the opposite point at the bottom of the pit. Walk backward until you can see your reflection and then use your height and your distance from the mirror to form the second triangle and proceed as before. (See figure 37. Paragraphs 11–12.)

Having covered objects in the plane of the measurer, the author now

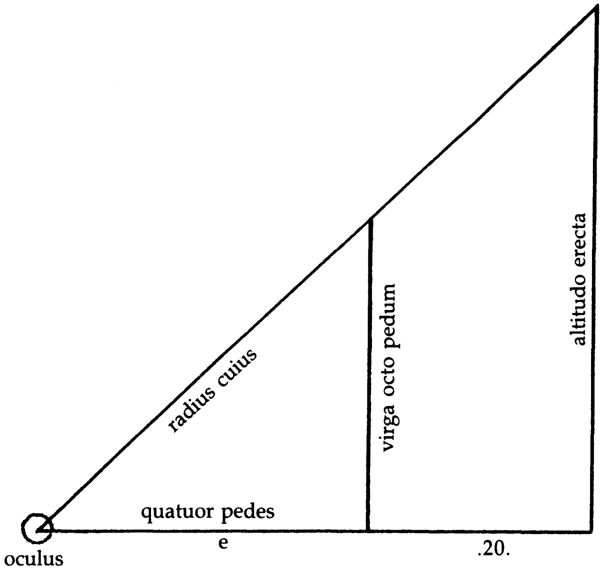

FIG. 32. ms *N*.

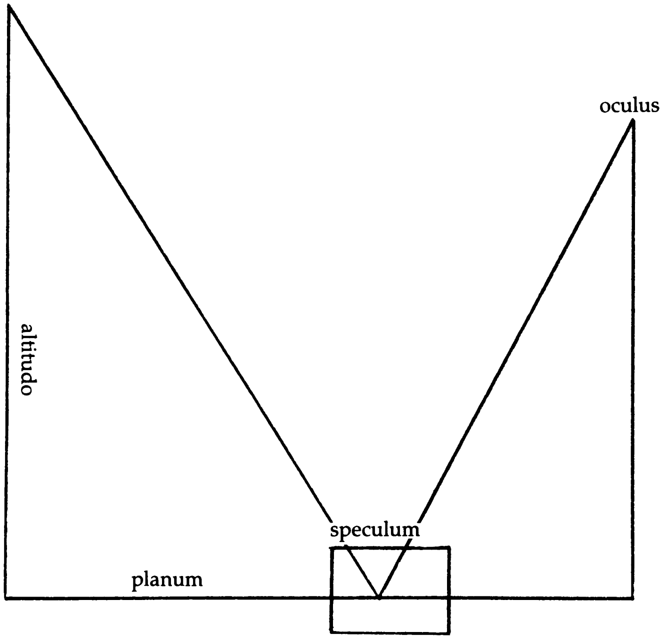

FIG. 33. ms *N*.

moves to heights of inaccessible objects, such as towers or mountains. Erect two perpendicular rods and, lying on the ground, sight the top of the tower through the top of each rod. Then measure the distance from your eye to the base of the rod in each case and subtract the lesser from the greater. Then measure the distance between the two positions of your

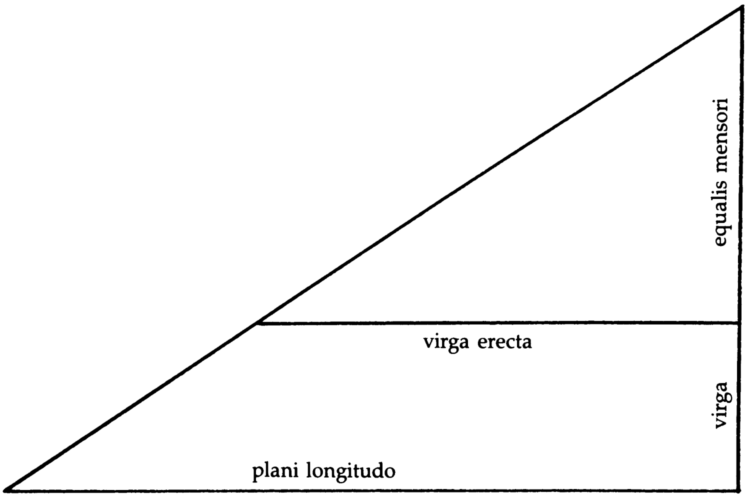

FIG. 34. ms *N*.

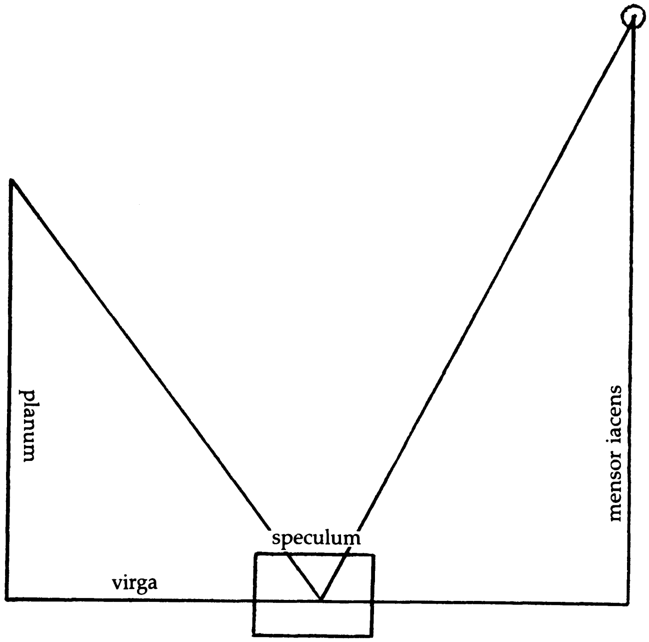

FIG. 35. ms *N*.

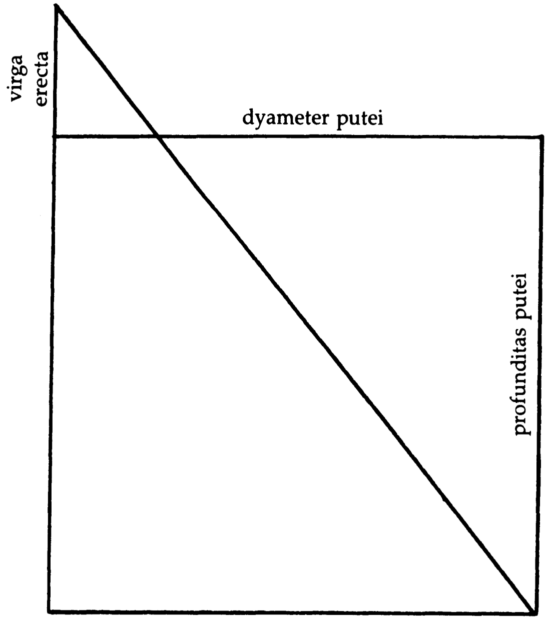

FIG. 36. ms *N*.

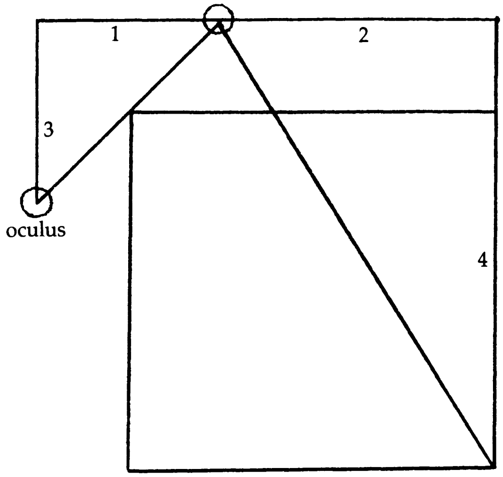

FIG. 37. ms *N.*

eye and multiply this by the lesser of the two previous distances. Divide this product by the excess of the greater base over the lesser, taken earlier. To this quotient, add the distance between the two eye stations to provide the distance between the farthest station and the base of the height to be measured. This line is the base of the larger of two similar triangles; the

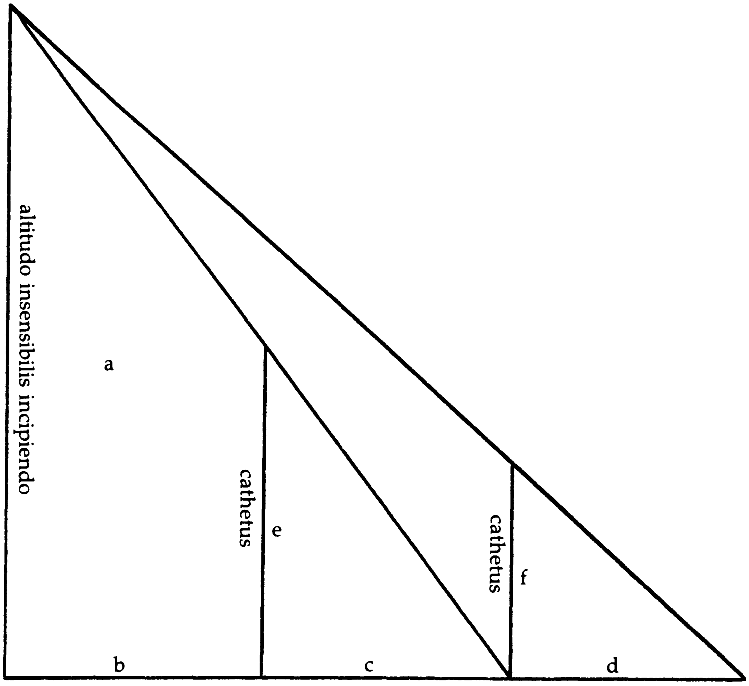

FIG. 38. ms *N.*

line between the farther station of the eye and the farther of the two rods is the base of the smaller. Proceed as usual with the proportions of the triangles to get the height of the inaccessible tower. (See figure 38.) If you wish the height of a tower located on top of an inaccessible mountain, proceed as above to learn the height of the mountain and again to learn the height of the tower taken with that of the mountain to arrive at the height of the tower alone. (See figure 39. Paragraphs 13–14.)

The next examples cited are the reverse of the inaccessible-mountain and the tower-on-the-mountain problems; the observer is on the mountain and wishes to know the difference between his elevation and that of the valley below or a tower in the valley. He follows the above procedure, in reverse, to obtain the depth of the valley. Again the distance down to the top of a tower in the valley below is determined by use of the two rods, the construction of similar triangles, and the subtraction of the lesser from the greater. (Paragraphs 15–16.)

From these explanations the author moves to a short discussion on the construction and use of the shadow square, an accurate instrument for use in all of the aforesaid problems.[137] The method, not explained, is by use of tangents and cotangents of the triangles involved. To make the instrument, build a precise and rigid square and mark two adjacent sides into twelve equal parts, or digits, for the use of a pointer (*gnomon*). If the instrument is large enough, each of the digits can be subdivided into sixty parts. On the angle opposite the angle shared by the marked sides, attach a ruler whose loose end can be moved from one side of the square to the other. Toward the ends of the ruler construct two small tables and draw two parallel lines on each, perpendicular to the side of the ruler; on both sets of lines place sighting holes that are equidistant from the surface of the ruler. (See figure 40. Paragraph 17.)

To use the shadow square, erect it so that the right divided side is perpendicular to the ground and the left divided side is horizontal. Point the angle to which the ruler is attached toward the object to be measured and, holding the square in this plane, move it until you can sight the top of the object being measured through both holes on the ruler. Determine the height as follows: If the ruler falls over the horizontal scale, note the number on the scale. Repeat the exercise farther back along a straight line and note this number on the same scale. Next, take the distance between the two stations and subtract the lesser distance from the greater. Proceed as discussed earlier in the proportions of similar triangles. (Paragraph 18.)

If the ruler falls on the perpendicular scale rather than on the horizontal, multiply the total of the side, twelve, by itself and divide the product by the number of digits above the ruler on the scale; the result will be the base sought. Then proceed as before to determine the second base, mea-

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[137] This is the shadow square which, according to Emmanuel Poulle, the twelfth-century astrolabists borrowed from the old quadrant. See Poulle, "Les instruments astronomiques de l'Occidente latin," p. 36.

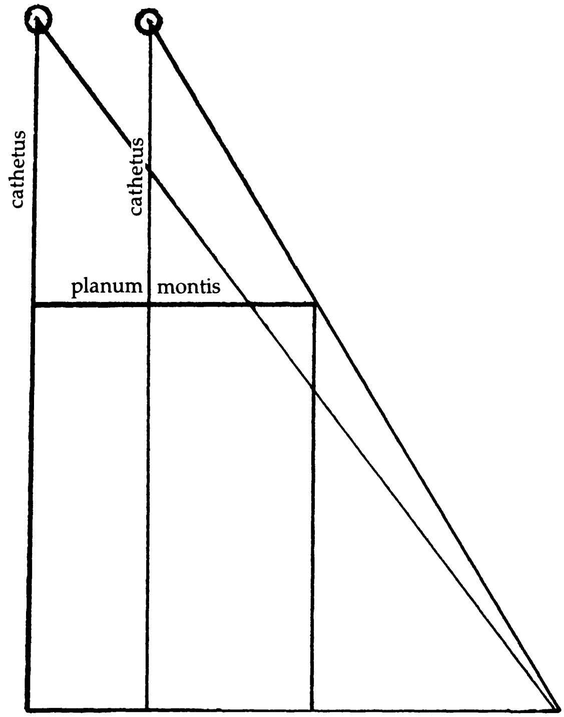

FIG. 39. ms *N*.

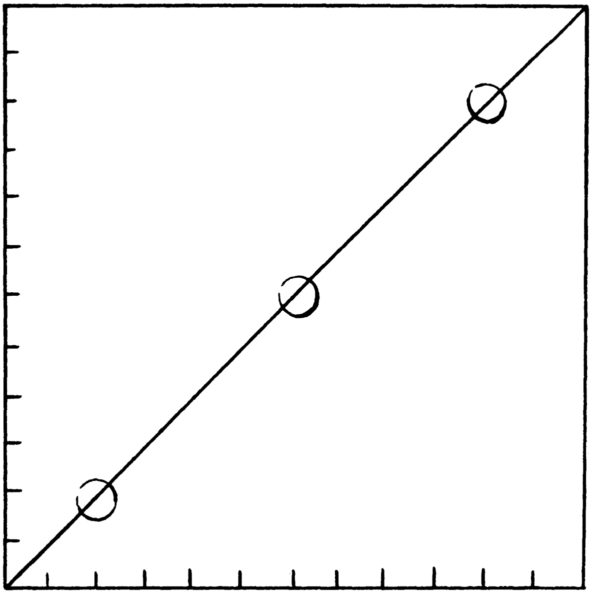

FIG. 40. ms *N*.

sure the distance between the two stations, and complete the problem. The author continues with the use of the shadow square. He demonstrates the solution of the same problems given earlier, to be solved by sighting from two stations as previously. (Paragraphs 19–20.)

One further problem concerns the author in the category of altimetry: that of fractions of measurements. His measurement from the beginning has been based on common units, as the foot, elbow, furlong, and mile. If by chance one's object comes out uneven in the given measure, he suggests that the measurer divide one whole unit into sixty parts or some other convenient number and determine how many of these parts remain beyond the number of whole units. (Paragraph 21.)

There follows a long survey of planimetry, or the measure of plane surfaces. The author explains that, just as one measures a linear unknown through a standard linear measurement, so he will measure an unknown square surface through a known square such as a squared foot or hand, called "contracted foot" or "contracted hand." (I have not found the origin of this particular term, but the meaning in this context is clear.) He begins with the surface of a square, to be measured or drawn in proportion to a known squared surface. Take the proportion of the lesser to the greater and multiply this proportion by itself, and you have the number of known measures in the larger surface. In the case of a rectangle, the author uses the standard formula of one side multiplied by an adjacent side for the surface. (Paragraphs 22–23.)

The writer now moves to triangles and describes in detail the procedure for determining the area of obtuse, acute, and right triangles. In each case he instructs the measurer to draw a perpendicular from the apex to the opposite side and then to take one-half of the base times the height. (Paragraph 24.)

The author next considers a multi-sided figure which is both equilateral and equiangular. In this case draw a perpendicular from the midpoint of one side into the center of the figure and a second from the midpoint of a second side. Note what would be the total length if there were similar lines drawn from all sides to the center and save this total. Measure the length of one side and multiply this by the number of sides in the figure; multiply this product by the total saved above. One-half of this product is the area of the figure. (This is an awkwardly composed paragraph, but the sense is there and the formula is correct. The writer is dividing the entire figure into right triangles and adding the total area of all of them for his sum. See figure 41.) In the case of a parallelogram, draw a perpendicular from base to base and multiply the base times the height. (See figure 42.) If a figure is neither equilateral nor equiangular, divide it into triangles, determine the areas of the triangles as aforesaid, and add these products together for the total area. If you have a portion of a circle which is larger than a semicircle, figure the area of the total circle and subtract the desired area from the total area. (See figure 43. Paragraphs 25–26.)

The author next moves to measurement of the surfaces of three-di-

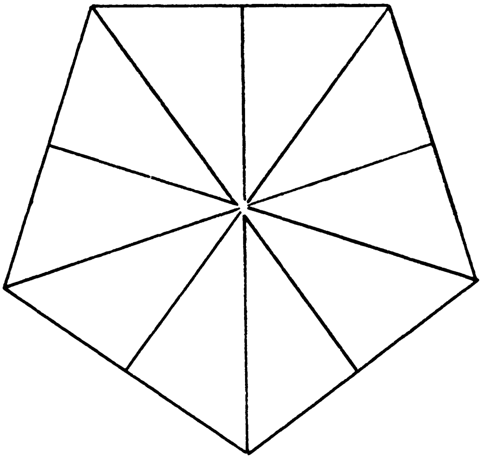

FIG. 41. ms *N*.

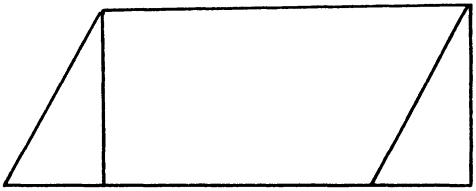

FIG. 42. ms *N*.

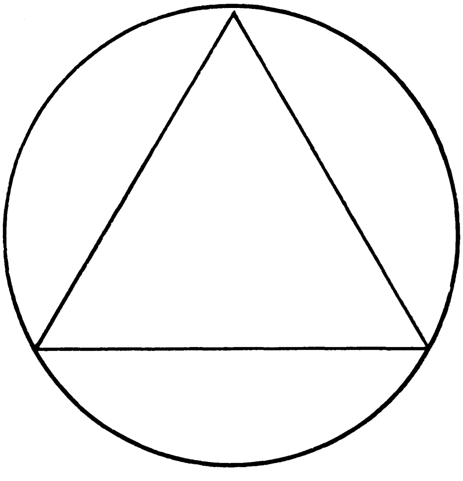

FIG. 43. ms *N*.

mensional figures. For a column, determine the height of the column and multiply this by the circumference of the base; the result is the area of the side of the column. For the total area of the column, find the areas of both bases by the aforesaid means and add these to the area of the side, derived above. In the case of a rounded pyramid, multiply the hypotenuse of the cone by the circumference of the base; one-half of the product is the area of the surface. To derive the total surface of the rounded pyramid, add to the above area of the base taken by the aforesaid formula for the area of a circle. For the area of the surface of a sphere multiply the diameter by the circumference at its widest point. To measure the area of a curved cask, multiply the height of the cask by one-half of the circumference of the mouth of the cask; repeat this operation with one-half of the circumference of the base of the cask and add the two products together (Paragraph 27.)

To measure a surface by the proportion of a smaller similar surface, take the proportion of a side of the larger to a corresponding side of the smaller, and square this proportion. The result is the proportion of the surface of the lesser to the surface of the greater. Once again the author offers instructions in case the unknown is not in whole units of the measure of the known. Divide the given measurement into sixty or some other number of equal parts, and the fraction of the measure is determined by the number of these sixty parts which remain. By this method, the author maintains, one can accurately work out the problems of the finest details. (Paragraph 28.)

The last section, considerably shorter than the others, concerns steriometry, or the measurement of the volume or capacity of three-dimensional figures. The author explains that here again the method of proportion is to be used, in this case comparing a smaller known body to the larger similar unknown. In the case of a cube, take the proportion of a side of the greater to a side of the lesser and cube this amount; the result is the proportion of the lesser cube to the greater. In the case of a column, cube the proportion of the axis of the larger to the axis of the smaller. By another method, you can cube the proportion of diameter to diameter, and the result is the proportion of volume to volume. Round pyramids and spheres may be treated in the same manner. This method may be used for any similar bodies, whether they have sided columns, sided cones, a mixture of spherical and faceted cones, or some other form. With this, the author closes his treatise on the use of geometry. (Paragraph 29.)

E. Procedures of Collation and Comments on the Relationships of the Manuscripts

a. Quadrans vetus

In the large group of manuscripts used in this study, certain guidelines naturally had to be adopted. One of the first problems encountered was the selection of a control manuscript for the text. Cambridge University Library Manuscript Ii. III. 3 (*A*) was chosen for several reasons: its date (circa 1300), the clarity of the handwriting, the general state of preservation of the manuscript and especially the sensibleness of its text and the lack of errors from carelessness or ignorance. The scribe apparently understood the text he was copying. This is not the case in several other manuscripts, as one can see by a number of variations recorded in the textual notes. The foliation which appears in the body of the text is that of the control manuscript.

The second problem is the handling of the vast variety of titles for sections of the text. Manuscript *A* has very few titles and therefore could not be used for this purpose. Manuscript *F*, Milan H 75 suppresso, although replete with nonsensical errors in the text, has the most complete set of titles and thus was chosen for use in this matter. In cases where this copy omitted titles when several other manuscripts included them, I chose the most appropriate of the ones offered. These usually were from manuscript *N*, Naples Oratoriana di Girolamini XI. For the remainder of the variations, in each case I placed the titles in alphabetical order by sigla. I combined duplications with the earliest appearance in this order.

Every significant variation from the text has been included in the textual notes. However, a number of minor variants appear, and the inclusion of these would have produced a very cumbersome edition and contributed little. I have purposely omitted these in the notes; I have not distinguished between *igitur, autem* and *ergo*, for example. Likewise in many cases variations in the mood or tense of a verb are unimportant for a critical analysis of the text. Examples are the interchange of *vis* and *velis* and of *habes* and *habebis*. There is also a frequent exchange of *ut* for *quod* in the manuscripts, as in paragraph 28. Such changes usually have been ignored, but some seemingly minor changes are recorded in the notes; these are included because of their importance in establishing families of manuscripts.

Manuscript drawings were also analyzed for evidence of familiar relationships among the copies. Representative drawings from various manuscripts have been included at appropriate points in the text. Seventeen manuscripts omitted the drawings, but the remainder followed a pattern that was quite consistent. Significant variations are discussed farther on in this chapter. Further variations usually occur in the quality of the drawing, not in the choice of subject matter or the manner of presentation. Those manuscripts which did not include the usual series are *PTWXfnptvwyαβγδελ*. One exception in the case of λ is discussed later in this section.

With the above guidelines established, I was able to handle the very large number of variations and draw some conclusions as to probable relationships among the manuscripts. There is no known holograph of the work and no way of guaranteeing the correctness of my choice when several logical options were offered. In such cases judgments were made according to the sense of the sentence and its context. All copies used in the collation were analyzed for a possible connection with one of the emerging families. The control manuscript, *A*, shared many variations with a large number of other copies, but there was no consistent pattern connecting manuscript *A* with any other particular manuscripts. Thus the control manuscript is not a member of any of the families established in this analysis. Its selection as the control is based on the reasons given earlier.

In looking over the textual notes of *Quadrans vetus* one can immediately see connections among several of the manuscripts. Repeatedly, small groups and even large groups use the same title, give the same alteration of the text, or follow other similar patterns. One must choose which of these patterns are significant and what they show in regard to relationships. I have chosen to omit titles as a criterion. They are often done either in a different hand or in such an embellished style that it is difficult to determine if they are in the same hand. Often they were added after completion of the text and were altered to fit a given space between paragraphs.

I have relied on marginal notes, whether they appear to be in the same hand or not. The notes usually are in a smaller, less formal hand than the book hand of the text. The fact that some were later additions does not discount a relationship among their manuscripts. In addition, some of the marginalia are incorporated into the text of other copies.

One group of manuscripts includes marginal references to Euclid and Archimedes as proof for the procedures being discussed. These have been checked and found to be correct. The Euclid references occur in paragraphs 5 and 8 and appear in Books I and III.[138] The Archimedes reference occurs farther on, in paragraph 70, and is attributed to both Archimedes and Alfarabius, without specific citations of either.[139] Additions of several words within the text also assist in grouping the manuscripts and showing probable relationships. For example, some thirty of the manuscripts have an addition of a complete sentence in paragraph 26, line 3. In another copy the scribe makes an omission error, skipping from a phrase in the preceding text to the same phrase in the addition. As a result, this manuscript, *L*, can be connected to the group including the addition.

Other points of comparison are brief additions, omissions and substitutions within the text. Even though most of these changes are small, the consistency and frequency of the same changes make connections between manuscripts almost undeniable. I have also used drawings as evidence of connections among manuscripts. This is more difficult to prove as a point of relationship, as the copyists might not have the same talent or tools. Yet the inclusion of a particular type of illustration or the lack of a common series of drawings offers some evidence for a connection within a group.

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[138] Euclid, *The Thirteen Books of Euclid's Elements*, trans. T. L. Heath (Cambridge, 1908; 2nd ed., New York, 1956), Book 1, Proposition 10: 1: 267–268; Proposition 11: 1: 269–270; Book 3, Proposition 29: 2: 60–61; all citations are from 2nd edition.

[139] Archimedes, *The Measurement of a Circle*, in *The Works of Archimedes with The Method of Archimedes*, trans. T. L. Heath (New York, n.d.), Proposition III, p. 93. According to Marshall Clagett, parts of *The Measurement of a Circle* were available to Arabic scholars by the late ninth century. The proof of the proposition of concern, Number III, on the value of *pi*, is included in the *Verba filiorum*, a work by the Banū Mūsā, three brothers working with Greek mathematical manuscripts at the Baghdad court in mid-ninth century. It is sensible to assume this to be known to Alfarabius, who died circa 950. See Clagett, *Archimedes* 1: 223 and 226–227.

I have not used the dates of the manuscripts as a crucial part of the evidence for my conclusions since all dates cannot be securely ascertained beyond centuries. In some cases there is internal evidence for the dating, but this is not frequent enough to aid in establishing these patterns. Thus the groups can be classified as related to each other, but their order of progression is purposely not discussed in most instances.

There is evidence, however, that some disputes over certain passages arose early in the history of the treatise. For example, manuscript *K* is dated internally as circa 1300. In one of the disputed passages, paragraph 39, the scribe is aware of at least two versions. The text describes a two-step procedure, the order of which is reversed in over half of the manuscripts collated. This results in an omission, paragraph 39, lines 3–4, and an addition in line 5. Manuscript *K* follows the omission-addition pattern but offers the textual version as a marginal note marked *Vel aliter*. Manuscript *n*, a fifteenth-century copy, gives the textual edition and then repeats the entire paragraph with the inclusion of the three-line addition. One can see by this and similar instances that some of the major variations occurred very early and continued throughout the period under study.

Most of the alterations in the manuscripts indicate connections among small groups at points where there are brief changes from the text. The largest frequent combination is *ILTceimryzζ*. However, the relationships of smaller groups are much stronger and more consistent. Therefore I will discuss the large group briefly and then dwell on the smaller groups.

Concerning manuscripts *ILTceimryzζ*, brief additions can be cited that are common to almost all of them. For example, there is a short addition included in one-half of the collated manuscripts, paragraph 35, line 1. There are several versions of this addition, but one rendition of it appears throughout this particular group. The same type of situation occurs with the series two lines later. Other brief additions, paragraph 63, line 1, and paragraph 83, line 4, can be cited for most of the same group of manuscripts.

Substitutions in this group occur *passim*. Some are brief while others are condensations of long, unnecessary phrases. Examples of the latter can be found in paragraph 35, line 1, paragraph 44, lines 4–5, and paragraph 47, lines 7–8. In the case of omissions, a number of one- or two-word examples could be cited. The most significant is found in paragraph 20, line 1. This is one of the most disputed passages in the text, and a large number of manuscripts offer various substitutions for an entire line. This group omits the phrase rather than giving any of the usual alternatives.

The first of the small groups is manuscripts *mr* with frequent parallels in *ζ*. Additions, whether in margins or within the text, are an important connection among these manuscripts. Two examples from Euclid will suffice for that type of citation. In paragraph 5, line 2, there is a Euclid citation added in the text of manuscripts *mr*. Again in paragraph 8, line 3, *mr* cite Euclid as proof of the proposition. Manuscript *ζ* does not include the Euclid notes but does join *mr* in several other additions to the text. In paragraph 1, line 8, in a definition of planimetry, *et longitudinem* is added to *latitudinem* by *mrζ* and two other manuscripts. Another short addition is found in paragraph 7, line 4: the phrase *in universo* is added by *mrζ*. Among the longer additions is an eight-line section following paragraph 47. Manuscripts *mrζ* are almost identical in this passage. Again, in paragraph 50, line 5, manuscripts *mr* include a seven-line marginal note dealing with the shadow square of the quadrant. Neither manuscript is clear in this note, but the questionable words are the same in both cases. In paragraph 53, line 4, *mr* join other manuscripts *Dl* and *q*, in a variation of directions on the use of ratio in the shadow square. However, the renditions of *mr* are practically identical and different enough from *Dl* and *q* that all five cannot be collated conveniently. Manuscript *ζ* rejoins *mr* in a textual addition in paragraph 72, line 1. It is an explanatory sentence following their common title for the paragraph.

In regard to drawings in this group, two-thirds of the manuscripts in this study contain a drawing of the quadrant. However, nearly all of these occur early in the section on its construction. Only *mrζ* and *U* present this drawing at the end of the treatise. A second distinction, confined to *mr*, is a detailed drawing of the shadow square with lines extended from it and labels to aid in its use. This occurs at paragraph 53, where the illustration is appropriate in the text. This drawing does not appear in any other manuscripts in this study.

One of the most common series of drawings in the manuscripts is that of a group of towers to illustrate the measurement of a height, either accessible or inaccessible. Manuscripts *mrζ* are among the very few copies which use only line drawings of appropriate triangles, with no artistic embellishments such as towers, hills, and scenery. In respect to the series of geometric and steriometric figures toward the end of the treatise, all three manuscripts follow the usual pattern portrayed in the appendix of drawings.

The next small group for consideration is that of manuscripts *Dcl*, with the occasional inclusion of *E* in some of the notable changes. This group is unusual in its extensive use of marginalia. Beginning in paragraph 4, line 1, *Dcl* offer a description of the contents of the adjacent text. The three manuscripts differ somewhat but are close enough to be collated. Again, as in *mr*, one finds references to Euclid in paragraph 4, line 8, paragraph 5, line 2 (omitted in *mr*), and paragraph 8, line 3. Another descriptive note on contents appears in the margin beside paragraph 8, line 1, in *DEcl*. This pattern is repeated at the beginning of paragraph 34 by *Dcl*. Here as in many other cases the marginal note is an elaboration of the title. A longer, more descriptive marginal note is found beside the beginning of paragraph 48. Again, *Dcl* have differences but are close enough to be collated easily. An explanatory note concerning the procedures with the shadow square is shared by manuscripts *DEbclt*. These are scattered over an area between paragraphs 51 and 65 but are collated in this edition at paragraph 51, line 6. The next lengthy marginal note occurs in prose form in *Dl* and in chart form in *Dc*. A similar paragraph appears in manuscripts *mr* with a chart form of this version in *E*. This note concerns the ratio problem of the shadow square and is collated at paragraph 53, line 4. Once more, at paragraph 64, line 2, *Dcl* present a marginal note descriptive of the contents of the adjacent text; there is no variation among them in the more than two-line note. A similar note, with one word changed in manuscript *c*, occurs at paragraph 85, line 1. There are a few shared omissions and substitutions in this group, but the key evidence for a connection is the marginalia. Manuscripts *Dcl* share the best collection of parallel and identical marginalia in the entire study. The circumstantial evidence for a connection among manuscripts is all but undeniable.

The manuscripts *Dcl* and *E* follow the general pattern of drawings that occurs in the illustrated manuscripts of *Quadrans vetus*. There are some variations, but there is nothing in the drawings that adds to their classification as a separate group.

A third group, one with less striking parallels, is *NSUVg*. The manuscripts *SUV* tend to be very close with the other two being rather consistent. This group is related primarily by small changes such as omissions and substitutions. For example, in paragraph 4, line 6, the phrase *ex omni parte* is omitted where it normally appears in the text but is inserted in the next clause. A phrase in paragraph 5, line 11, is reduced to one word in *SUVg*. Three lines later the word *circumferentiales* is substituted for *circulares* by *SUVg*. Again, in paragraph 9, line 5, the word *circini* is added to *pes* by *NSUVg* and six other manuscripts. Several small changes in declension occur in *NSUVg* in paragraph 15, line 3. This group remains together in most of the changes that occur in the very much disputed passage of paragraph 20, line 1. Other such changes could be cited. The one addition that should be noted is that of *NSUV* in paragraph 72, line 2, an explanatory phrase that is also included by five other manuscripts. A noticeable omission of *SUV* is the clause found in paragraph 83, lines 4–5. This is not omitted by any other manuscript studied. These changes, as indicated, are not uniform; manuscripts *N* and *g* do not always follow the pattern. Yet there are enough similarities to maintain that the five manuscripts have some connections in their origins. All are fourteenth-century copies. From the circumstantial evidence, one can suggest that manuscripts *SUV* are, in some sequence, direct or indirect copies of *N* or *g*. This at least would account for the omission of the clause in paragraph 83, lines 4–5, not omitted in any other copy of the treatise used in this study. The substitutions listed above which are found in *SUVg* would suggest that manuscript *g*, rather than *N*, is the source of *SUV*. This is conjecture, but the two-line omission of *SUV* gives credence to the argument.

The one conclusion on drawings in this group is that they are generally sparse and unimpressive. Manuscripts *SUV* stand out particularly as a group in this matter. They have none of the most common body of drawings, those of height measurement usually involving towers. The series of geometric and steriometric figures at the end is omitted by *UV* and done very sketchily, without labels or detail, in *S*. There is no evidence here to support the source of *SUV* as being either *N* or *g*.

Another group, *nλ*, presents a stronger case for a connection than some of the above. There are numerous examples of brief substitutions, omissions and additions in which the two are parallel. Much more important are the long additions that occur from time to time in the text. A three-line addition to the text occurs at the end of paragraph 43. This note is not found in any form in any other manuscript studied. Again in paragraph 51, line 5, an explanatory clause is added that is not provided by another manuscript. A similar note occurs in paragraph 52, line 3. Just above this is the key omission for this group: a skipping from *umbre* to *umbre* that omits five lines of text, paragraph 51, line 6, to paragraph 52, line 3. This error is shared only by *nλ*. The numerous brief changes found in *nλ* are frequently shared by one or more other manuscripts and are thus not cited. The ones mentioned here set the two apart in a way that demonstrates an undeniable relationship. Which is the source of the other or whether they share a common, unknown source, I do not know. Both are fifteenth-century copies now located in Italy.

Concerning illustrations, these manuscripts share a negligible amount. Manuscript λ has a sketch of the quadrant on the first folio, before the treatise begins. This drawing is somewhat different from the usual presentation. The shadow square is drawn to touch the limbus, a characteristic occurring in only one other drawing in this study, that of manuscript *q*. Manuscript *n* has two insignia of initials drawn within Christian crosses in the top margin of the first folio. The total lack of other illustrations is questionable as evidence for a connection, as this lack is shared by fifteen other manuscripts in this study. Yet, coupled with the textual evidence, it has some value.

Another group that follows the same trends in small changes throughout the text is *MQZjquη*. This group, again, is related primarily in one- or two-word changes, mostly substitutions. Manuscripts *jη* do not stick as closely to the pattern as the others. Additions and omissions can be found in paragraph 15, lines 6 and 9, and paragraph 16, line 1. A brief addition, *cuiuscumque diei*, occurs in all of these manuscripts in paragraph 42, line 1. A longer substitution occurs in paragraph 42, line 5.

The strongest connection of this group in their illustrations is in the section of measuring of heights. All of the manuscripts include at least one and usually several towers, most of which are well-done. Yet, again, this is the area within the illustrations that is most common to all the manuscripts studied. Therefore, one must say that the value of the illustrations in the group is their tacit support of a strong connection among the manuscripts based on textual changes.

Another point of possible association of manuscripts in groups is in the inclusion of diagram letters in the text. This varies considerably throughout the treatise. The first section, describing the construction of the instrument, commonly includes letters, even in the text of manuscripts not containing drawings of the instrument. On reading the instructions one can see that diagram letters would be highly beneficial, especially if no drawing is included. However, there is little to be learned about familiar relationships among the manuscripts from these symbols.

The next section, concerning measurement of heights, is one of the two parts of the text most widely illustrated. The drawings are frequently of towers with individuals holding the quadrant and sighting the top of the tower. These illustrations are self-explanatory and do not require diagram letters. Farther on in the text, in the measurement of horizontal lines and planes, letters reappear in the text and on the diagrams as they are needed. These drawings are usually of similar triangles and are not self-explanatory. The last series of illustrations, of various plane and steriometric figures, also omits letters from both text and illustrations. These diagrams, of various types of triangles, containers for measurement of volume, and depths of pits, are self-explanatory and are easily matched with the appropriate portions of the text.

Some manuscripts use diagram letters or other notations at every possible opportunity. The majority, however, follow the procedure just described. There is no discernible pattern such as appears in the textual changes. Thus, this area contributes no significant evidence for the establishing of families of manuscripts.

b. Geometrie due sunt partes principales

The number of manuscripts available for this study is much smaller than that of *Quadrans vetus.* I have located twenty copies, most of them complete. Fourteen are included in the collation. As in the longer treatise, the dates assigned to the manuscripts are usually from catalogs of the libraries now possessing the items. Many of them must be considered with some skepticism. The earliest suggested dates, for four manuscripts, are all thirteenth century.[140] One of these, Venice Bibliotheca Marciana 332 (IX, 6) (*A*), was selected as the control copy on the basis of its suggested date, clarity of handwriting, and relative freedom from discernible errors.

The brevity of the text and the small number of manuscripts enabled me to include more minor deviations than I recorded in the collation notes for *Quadrans vetus*. Such small differences as interchanges of *igitur, ergo,* and *autem* are included in the notes, as well as changes in mood and tense of verbs, as in the case of *velis, vis* and *volueris*. These minor changes however, are not a basic part of the evidence used in dividing the manuscripts into related groups; more precise and important textual changes supply adequate evidence for establishing relationships. Chapter titles are not used in this matter, as they occur only in manuscript *I* and are rare in it. Drawings are used in cases in which they are provided. Manuscripts *ACIK* have none, and *FGM* include only a few of the usual series. Manuscript *D* is a fragment and contains only those appropriate to the part of the text which it includes. Manuscripts *BHJ* contain almost complete series, although many in *J* are incomplete sketches. The remaining copies, *ELN,* are uniform in their drawings, illustrating various propositions throughout the treatise. Letters within the text which refer to drawings are too rare to be an important part of the comparative study of manuscripts. As in the case of *Quadrans vetus* a representative series of drawings is included at appropriate points in the text.

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[140] London, British Library, Royal 12 E XXV, ff. 152r–155r (*B*); Oxford, Bodleian Library, Ashmole 341, ff. 143v–144v (C); Vatican City, Bibliotheca Apostolica Vaticana, latin 3114, ff. 81v–83r; Venice, Bibliotheca Marciana, fondo antico 332 (IX, 6), ff. 236v–239v (*A*).

References to external sources are much rarer in copies of *Geometrie due sunt partes principales* than in those of the longer treatise. A reference to Archimedes occurs in one copy, manuscript *N,* and appears in paragraph 30. This quotes the first proposition in the *Measurement of a Circle* and is accurately stated.[141] The same manuscript also contains nine references to Euclid. One of these notations is quoted in manuscript *L*. All of the citations have been checked, and most are found to be accurate.[142] None of the references to Euclid duplicate any of those quoted in *Quadrans vetus*. They usually refer to the set of basic rules set forth at the beginning of *Geometrie due sunt partes principales* which are not included in the longer treatise.

The manuscripts of *Geometrie due sunt partes principales* have been studied internally in regard to possible relationships among the copies. Two groups have evolved from the fourteen copies and fragments available: manuscripts *GHK* and *AELN*. Other copies in the collection occasionally join these, but the two groups tend to be consistent in their changes, with or without the others, throughout the treatise. Numerous one-word substitutions, omissions and additions can be cited for each family. However, I will deal chiefly with the more lengthy changes.

The family *GHK* begins its changes in paragraph 1, with a typical substitution: *quantitatum* reads *quantitates et eorum*. Paragraph 3 has several short changes, usually shared solely by the three copies. This sprinkling of minor changes continues throughout. Among the changes, abridgements are a primary characteristic of the group. The first notable abridgement occurs in paragraph 4, where the phrase *sive continue sive discontinue* is reduced to *continue* by *GHK*. This restricts the sentence and makes it mathematically inaccurate. It might be noted that five other manuscripts omit the phrase entirely and one, *B*, supplies it only in the margin. Many of the brief changes are omissions of transitional or explanatory words and phrases, as *item, enim, semper, quod,* and *mensura tua* (this last when the meaning is implicit in the sentence). Occasionally, however, the group includes an addition that is obviously intended for clarification of meaning. In paragraph 15, the phrase *est profunditas vallis* has added to it *sive altitudo montis*. Two similar additions are in paragraph 22. *Pedem* has added to it *vel aliam mensuram;* the sentence is extended by *et sic de aliis*. Again, in paragraph 30, *altitudines* has added to it *sive longitudines*. The last such expansion for clarification occurs in the same paragraph. The phrase *que eadem est* is replaced by *quod ad idem redit et loquor*. In each of these last cases, manuscripts *GHK* are the only ones containing the changes. Thus the majority of the changes of this group are omissions, apparently for the purpose of economy of words and materials. The small number of additions seems to be intended for needed clarification.

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[141] Ibid., p. 91.

[142] Euclid, *Elements*, Book 5, Definitions 9 and 10: 2: p. 114; Book 6, Proposition 4: 2: pp. 200–202; Proposition 17: pp. 228–229; Proposition 18: pp. 229–232; Proposition 24: pp. 252–254; Proposition 26: pp. 255–256; Book 11, Proposition 36: 3: pp. 356–358; Book 12, Proposition 10: 3: pp. 400–409; Proposition 15: pp. 420–423 and 434–438. The references are correct with the following exceptions: Book 11, Proposition 36 should read Proposition 37, and Book **12**, Propositions 10 and 15 should read 11 and 18 respectively. The references shared by manuscripts L and N (paragraph 23, notes 2 and 7 of the text) are only indirectly related to the material cited in the text.

The group is far too uniform in its changes for one to deny some connection among them. The problem of dating does not help in establishing the exact relationship, however. One possible clue in this problem is the absence of drawings in manuscript *K*. Manuscript *G* contains a few early ones in the series, while *H* contains almost a complete set. On this basis, one could consider *H* as the source of *G* and suggest that *K* is a copy of either of them or of an intermediate copy. The alternative would be that *G* or *H* was copied from *K* (or an intermediate copy) and that the drawings were then taken from another available copy. If the latter were true, it would seem likely that there would be internal changes and corrections from the supplementary copy, and this is not apparent in the texts.

The second group of manuscripts, *AELN*, is less frequent and less consistent in its changes than the first group. The changes are shorter and are usually additions for clarification or elaboration. One of the longest additions is found in paragraph 7: *planum* is followed by *super quod erigitur magnitudo*. Words such as *predicte* are occasionally added to a phrase for clarification, as in paragraph 18. Again, in paragraph 19, the word *quesita* is followed by *primo loco*. In paragraph 28, one finds *occulte* added to *columpne* in manuscripts *AEL*. These also add *superficiem rationalem* to *planimetria* in paragraph 30. The last two examples do not appear in manuscript *N*. However, possibly the most important textual connection for the group is a repetition, and this involves all four manuscripts. Again, in paragraph 30, the opening phrase of a sentence, *Et si speram per sperullam*, is repeated by these manuscripts and no others.

The use of drawings in the study of this group is helpful. The oldest of the group, *A*, has no drawings in this treatise although it includes many in other works contained in the manuscript. Yet the remaining three, *ELN*, are the only manuscripts in the entire group that contain the complete series. Obviously if the dating I have available is correct, these later copies were made with the use of some manuscript other than *A* or in addition to it. It should also be noted that this group includes the only copy, *N*, which contains numerous references to Euclid and the one to Archimedes. The marginal note containing one of these to Euclid is repeated almost verbatim in manuscript *L*. This small inclusion points to some connection between manuscripts *L* and *N*, but this is too insignificant to establish *N* as the source of *L*. One addition, paragraph 12, strengthens the connection, however. The following sentence is inserted in the two manuscripts: *Et exibit totus cathetus a plano speculi usque ad profunditatem putei* (*per quartam regulam* added by *L*). On the basis of the two clues, one can suggest the possibility that *L* is derived from *N* or from an intermediate copy. Yet, as with the first family group discussed, my only firm conclusion must be that the four manuscripts, *AELN*, form a related group. With the limited number of extant copies available and the dating problems which are involved, I can say nothing more definite about connections within either of these groups.

QUADRANS VETUS

TEXT AND NOTES

Manuscript Sigla for *Quadrans vetus*

A	Cambridge, University Library, Ii.III.3, ff. 56r–60r, ca. 1300.
B	Bruges, Bibliothèque publique de la Ville de Bruges, 528, ff. 25r–32v, 13th c.
C	Copenhagen, Bibliotheca regia Hafniensis, Ny Kgl. S. 275a, ff. 64r–72v, 13th c.
D	Darmstadt, Hessische Landes- und Hochschulbibliothek, 2661, ff. 135r–143r, 13th c.
E	Cambridge, Fitzwilliam Museum, McClean 166, ff. 3r–8v, 13th c.
F	Milan, Bibliotheca Ambrosiana, H 75 sup., ff. 52r–56v, a. 1284.
G	Paris, Bibliothèque Ste. Geneviève, 1043, ff. 43r–48v, 13th c.
H	London, British Library, Harley 3647, ff. 55r^{a}–60r^{b}, 13th c.
I	Bamberg, Staatliche Bibliothek, 1 (HJ.V.1), ff. 43r–53r, 14th c.
J	Paris, Bibliothèque Nationale, fonds latin, ff. 76r^{b}–80r^{b}, 13th c.
K	Princeton, University Library, Robert Garrett 99, ff. 162v–168v, 13th c.
L	Munich, Bayerische Staats-Bibliothek, 353, ff. 33v–38r, 13th c.
M	London, British Library, Royal 12 C XVII, ff. 61r–71v, 14th c.
N	Naples, Oratoriana di Girolamini, XI (C.F.I.26), ff. 11r–15v, 14th c.
O	Paris, Bibliothèque Nationale, fonds latin, 7195, ff. 36r–41v, 14th c.
P	Oxford, Corpus Christi College, 41, ff. 173r–179v, 14th c.
Q	Oxford, Bodleian Library, Ashmole 1522, ff. 70r–78r, 14th c.
R	Paris, Bibliothèque Nationale, fonds latin, 7298, ff. 55v^{a}–59r^{a}, 14th c.
S	Oxford, Bodleian Library, Canon. Ital. 157 (20209), ff. 1r–6v, 14th c.
T	Paris, Bibliothèque Nationale, fonds latin, 7267, ff. 15r^{b}–17r^{b}, 14th c.
U	Venice, Bibliotheca Marciana, VIII, 77 (XI, 79), ff. 14v–17v, 14th c.
V	Paris, Bibliothèque Nationale, fonds latin, 7416B, ff. 51v^{a}–57v^{a}, 14th c.
W	Paris, Bibliothèque Nationale, fonds latin, 15,121, ff. 37r^{a}–44r^{b}, 14th c.
X	Paris, Bibliothèque Nationale, fonds latin, 15,125, ff. 49r–53r, 14th c.
Y	Florence, Biblioteca Medicea Laurenziana, Plut. XVIII, sin. cod. 3, ff. 59r–(66v), 14th c.
Z	Florence, Biblioteca Medicea Laurenziana, Plut. XVIII, sin. cod. 6, ff. 59v–(68r), 14th c.

a	Vatican City, Bibliotheca Apostolica Vaticana, Urbinas 1408, ff. 1r–6r, 14th c.
b	Bruges, Bibliothèque publique de la Ville de Bruges, 522, ff. $51r^{a}$–$57r^{a}$, 14th c.
c	Cambridge, University Library, Ii.I.15, ff. 11r–15r, 14th c.
d	Paris, Bibliothèque Nationale, fonds latin, 7194, ff. 39r–44r, 14th c.
e	Erfurt, Wissenschaftliche Bibliothek der Stadt, Amplonian F 376, ff. 54r–57v, 14th c.
f	Erfurt, Wissenschaftliche Bibliothek der Stadt, Amplonian Q 348, ff. 46v–53v, 14th c.
g	Erfurt, Wissenschaftliche Bibliothek der Stadt, Amplonian Q 369, ff. 169v–172r, 14th c.
h	Erfurt, Wissenschaftliche Bibliothek der Stadt, Amplonian Q 386, ff. 151r–156v, 14th c.
i	Madrid, Biblioteca Nacional, 8883, ff. $36r^{a}$–$39r^{b}$, 14th c.
j	London, British Library, Egerton 844, ff. 49r–55v, 14th c.
k	London, British Library, Harley 3735, ff. 64r–70r, 14th c.
l	London, British Library, Royal 12 C IX, ff. 23r–28v, ca. 1300.
m	Milan, Bibliotheca Ambrosiana, H 109 sup., ff. 22v–27v, 15th c.
n	Milan, Bibliotheca Ambrosiana, I 253 inf., ff. 2r–10r, 15th c.
o	Oxford, Bodleian Library, Bodley 472(2492)(17), ff. 115r–120v, 15th c.
p	Paris, Bibliothèque Ste. Geneviève, 1048, ff. 141r–148r, 16th c.
q	Paris, Bibliothèque Nationale, fonds latin, 7414, ff. 41r–53v, ca. 1512.
r	Naples, Biblioteca Nazionale, VIII C 49, ff. 126r–129v, ?13th–14th c.
s	Vatican City, Bibliotheca Apostolica Vaticana, Barberini 276, ff. 72r–87v, a. 1473.
t	Vatican City, Bibliotheca Apostolica Vaticana, Palatine 1414, ff. 168r–173r, 14th–15th c.
u	Florence, Biblioteca Nazionale, II, III, 24 (Magl. Cl. XI, num. 117), ff. $176v^{a}$–$179v^{b}$, 14th c.
v	Vatican City, Bibliotheca Apostolica Vaticana, latin 4084, ff. 23r–25r, 15th c.
w	Assisi, Biblioteca del convento di S. Francesco, 174, ff. $101r^{a}$–$105r^{a}$, 14th c.
x	Florence, Biblioteca Nazionale, II, III, 22, ff. 268r–282r, 16th c.
y	Naples, Biblioteca Nazionale, VIII C 36, ff. $36v^{a}$–$39r^{b}$, ?14th–15th c.
z	Lyon, Bibliothèque de Lyon, 172(104), ff. 69v–81r, 15th c.
α	Cambridge, Trinity College, 1285 (0.5.4), ff. $287v^{a}$–$289r^{a}$, 15th c.
β	Manchester, John Rylands Library, 66, 67, ff. 231r–236r, a. 1474.
γ	Metz, Bibliothèque de Metz, 284, ff. 85r–94r, 15th c.
δ	Bologna, Biblioteca Universitaria, 154, ff. 120r–125r, 14th c.
ϵ	Krakow, Biblioteka Jagiellońska, 548 (DD III 67), pp. 147–160, 14th–15th c.

ζ	Vatican City, Bibliotheca Apostolica Vaticana, latin 3114, ff. 69r–74r, 14th c.
η	Paris, Bibliothèque Nationale, fonds latin, 7437, ff. 119r–125r, 15th c.
θ	Munich, Universitätsbibliothek, Q 738, ff. 77r–83r, a. 1442.
ι	Paris, Bibliothèque Nationale, nouvelles acquisitions, 1893, ff. 41v–46r, 14th c.
κ	Paris, Bibliothèque Nationale, fonds latin, 7336, ff. 298r^{a}–304r^{b}, 15th c.
λ	Venice, Musèo Correr, Cicogna, 2712, ff. 110v^{b}–113v^{b}, 15th c.
μ	Krakow, Biblioteka Jagiellońska, 613, ff. 156r–158v, 14th–15th c.
ν	Bologna, Biblioteca Universitaria, 1845, ff. 106r^{b}–110r^{b}, 14th c.

QUADRANS VETUS

Incipit tractatus quadrantus magistri Johannis de Montepessulano

1. Geometrie due sunt partes theorica et practica. Theorica est que sola mentis speculatione quantitates proportiones et earum

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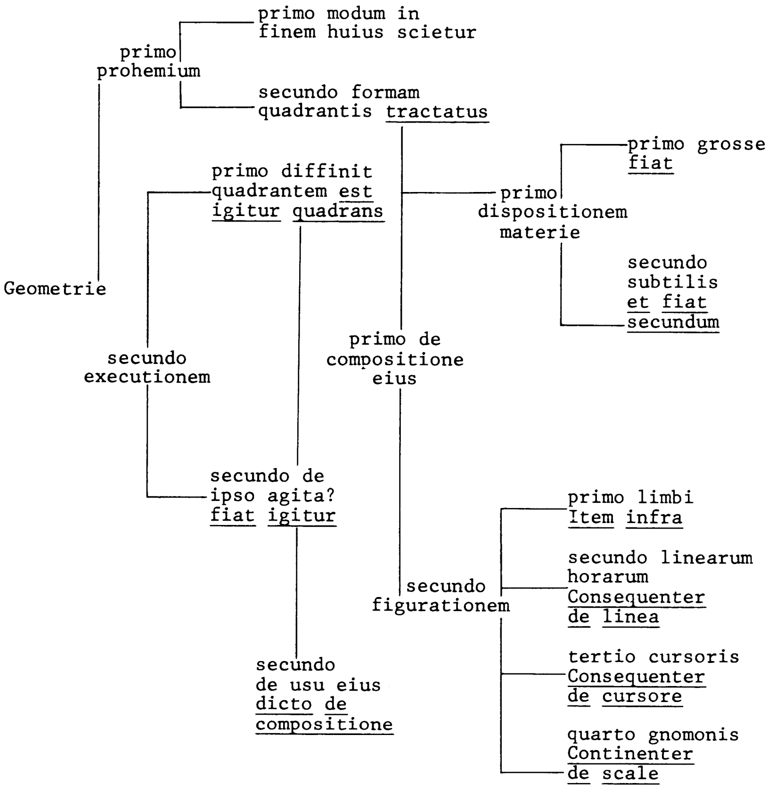
1 Incipit (56r) tractatus quadrantis editus a magistro Johanne in Montepessulano *A*, Incipit tractatus quadrantis et primo de eius compositione *CU*, Incipit quadrans *DKblγ*, Incipit tractatus de compositione et utilitate quadrantis veteris *Gp*, Prohemium in compositionem et utilitatem quadrantis secundum modernos (Rubrica H) HRY, Incipit quadrans magistri Roberti Anglici (*last three words in different hand*) *J*, Incipit tractatus quadrantis veteris secundum magistrum Johannem in Montepessulano *MQjqu*, Incipit quadrans secundum Linconiensem episcopum *N*, Incipit practica geometrie Magistri Roberti Anglici de Monte Pessulano *S*, Incipit quadrans magistri Johannis Anglici in geometria *T*. Incipit tractatus quadrantis et de eius compositione adque (sic) utilitate secundum modernos *W*, Incipit tractatus quadrantis *Zkmrsδ*, Incipit tractatus quadrantis habens duas partes principales prima est de compositione instrumenti. Primum capitulum de notitia huius artis in generali *a*, Incipit quadrans magistri Johannis Anglici in Monte *cei*, Incipit canon quadrantis veteris *g*, Incipit quadrans prohemium *h*, Incipit ars quadrantis et eius operatio n, Incipit quadrans magistri Roberti Anglici de Montepessulano *t*, Tractatus quadrantis *w*, Prohemium quadrantis secundum usum modernorum incipit *x*, De compositione quadrantis et eius operatione *α*, Incipit tractatus de compositione et utilitate quadrantis secundum modernos *β*, Hic incipit quadrans *ε*, Incipit tractatus quadrantis veteris magistri Johannis in Montepessulano *η*, Tractatus quadrantis cum cursore *θ*, Incipit tractatus quadrantis secundum modernos prohemium *ι*, Incipit tractatus quadrantis communis *κ*, Magistri Roberti Anglici quadrantis compositio ex qua geometrie exercitium habetur feliciter incipit *λ*, *tit om rell*

(Geometrie h) Quia ulla ars ullaque operatio sive debitis ad perfectum deducitur instrumentis et quanto nobilior (est h) ars tanto pluribus indigentes instrumentes numerus. Si astronomia cum omnibus sit prestantior pluribus elegantionibus quod (quia h) instrumentorum amminiculis fulciatur. Cuiuslibet pluraliter sint instrumenta ut pote (potest h): quadrans, chilindrus, horologium, astrolabium, saphea, armilla, et turketus et cetera. Hec tunc per viam breviorem integretatis scilicet quadrans astrolabium et turketus sunt maxime operative. Idem aliis ad presentes? omnisses de hiis solummodo speculemur (specificemur h). Et primo (productum h). Et primo (productum h) de quadrante que (quod h) est materia huius (hoc h) licet? (habet? h). Cuius causa efficiens est quadrans conjunctabilis? quocumque sit (om h) ille. Causa finalis est (dictis patet? /prius?7 K) (exteras pars h). Causa formalis duplex: forma trianguli (?) que est (om h) practica (dicitur h) et forma (vero h) tractatus que consistit in divisione libri et (?) in prohemium et igitur (om h) (executor incipit ibi h) (quartem et executionem que est (?) ille est igitur K) (sed /?7 h) quadrans in prohemio primo de specibus geometrie ut eliciat necessitatem? de circulo? Secundo formam exertatur (om h) initiit (om h) (tractatus igitur K) (tractatus /?7 id est /?7 /?7 istum h) mg Kh, In nomine trino hoc opus incipio mg a, Quadrans mg d, Liber mei Francisci sitoni Regii et ducalis camere ac communis multi architecti mg n.

2. Geometrie7 Geometrice Y; sunt om k, species vel add γ; partes7 species EIJKhtwβδ, scilicet add NSUghnsαβζγ, et om a

Primo quod pars theorica mg K; Geometrie Primo dividatur primo in prohemio et tractatus illi est igitur primo permittit divisionem geometrie valentem ad propositum; secundo dat modus procedendi; tractatus est igitur in 2 dividitur primo docet compositionem quadrantis, secundo utilitatem eius; ille dicto de compositione quadrantis mg c; Id est speculationem et id est operationem mg ζ

Chart of contents, ms b:


primo modum in finem huius scietur
primo prohemium
secundo formam quadrantis *tractatus*
primo grosse *fiat*
primo diffinit quadrantem *est igitur quadrans*
primo dispositionem materie
Geometrie
secundo subtilis *et fiat secundum*
primo de compositione eius
secundo executionem
secundo de ipso agita? *fiat igitur*
primo limbi *Item infra*
secundo linearum horarum *Consequenter de linea*
secundo figurationem
secundo de usu eius *dicto de compositione*
tertio cursoris *Consequenter de cursore*
quarto gnomonis *Continenter de scale*

3 mentis *om By*, in *add k*; speculatione *om M*; quantitates] rerum et *add q*, vel quantitatem *add s*; proportiones] rerum *add Muη*; earum] rerum *v*, aliter quantitatem *supralin f*

mensuras intuetur. Practica est quando alicuius rei quantitatem ignotam experimento sensibili mensuramus. Mensurationis autem artificialis, que practica dicitur, tres sunt species, scilicet altimetria, planimetria et steriometria. Altimetria est quando solam rei altitudinis longitudinem querimus. Planimetria est quando rei latitudinem querimus. Steriometria est quando longitudinem,

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1 intuetur7 metitur I; Practica7 autem add x; alicuius7 altitudinis β; rei om K, remote add B; quantitatem om d, rei add y

Secundo quod practica mg K

2 ignotam7 notam y, om B; sensibili7 vel mensurabili add γ; autem7 sensibilis add ι, om J

Sequitur sunt species practica mg K

3 artificialis om UVg; que7 a add μ; dicitur om d; tres7 enim add α; sunt7 partes add q; scilicet om DEFKTbceiqγμ

4 et om a; steriometria7 geometria y

Altimetria que est mensura in alto mg ζ

5 solam7 solummodo a; rei om Up; altitudinis om Uq, vel add wδθ; longitudinem7 rei J, om qv; querimus7 mensuramus SUVg; quando7 solam add gv

6 rei7 longitudinem et B; latitudinem7 longitudinem W, altitudinem δ, et longitudinem add Smnrsvζλ; querimus7 mensuramus B; est om FRmo; quando7 Cum q; longitudinem om gkt, rei add avwδιμ, querimus add μ

latitudinem et profunditatem investigamus. Primo modo mensuramus linearum dimensionem, secundo modo dimensionem superficialem, tertio modo dimensionem corporalem.

2. Tractatum igitur istum, in quo docebus mensuras omnium rerum cognoscere secundum quod ad introductionem artis pertinet, in duas partes dividimus. Nam in prima parte tractabimus de quadrantis

---

1 et *om a*; profunditatem7 (rei *α*) querimus et *add ABCGHIMOPRXYZhjop quxεηθικ*, corporum *add λ*; investigamus7 querimus *dμν*; altitudinis... investigamus7 altitudinem et profunditatem querimus *y*; Primo7 (enim *v*) investigamus et *add RYvζκ*; modo7 altimetria *supralin f*; *om μ*; longitudinem ... mensuramus *om W*

Hoc secundo habentur tres species practice. Tres species practicis comparat. Hoc secundo dat formam tractatus et primo quod agetur in prima parte *mg K*

2 linearem7 per *add F*; dimensionem^{1}7 mensurationem I, *om ACGpqμ*; modo om *UXovαβθλμν*, per planimetriam *supralin f*; dimensionem^2 *om BHIPQRW XYZmnoruvxαβηθικΥ*; superficialem7 dimensionem *add E*

3 modo *om INUvαβθμν*; per steriometriam *supralin f*

4 Tractatum7 est *add O*; docebimus7 describimus *C*, debemus *d*, omnes *add α*; omnium *om R*, in quo *add w*

Instrumenta geometrie; quadrans, chilindro (*stet*), horalogium, astrolabium, safea, armille, turketus *mg I*; Sequitur tractatus *mg b*; Primum: Executa notificat primo quid sit quadrans *mg l*

5 rerum *om R*; cognoscere7 quantum ad id *add η*; secundum *om O*; ad *om yε*, interrogatorum *add T*; introductionem7 instrumentum *θ*, Istius *add η*

6 duas7 3*μν*; secunda *add Z*, quia *supralin f*; tractabimus7 determinabimus *Faμ*; Nam ... tractabimus *om i*; quadrantis7 te *add O*

compositione, dicti a quarta parte circuli quam continet; in secunda parte, de opere quod per ipsum exercetur et de utilitatibus eius.

Quid est quadrans et de eius formatione

3. Est igitur quadrans quoddam instrumentum quartam partem circuli et quasdam linearum protractiones continens, per quod

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1 quarta om κ; parte om W; quam om Cθ; continet 7 obtinet T, pertinet y, om Cθ; dicti...continet om Bd; in om Yw; secunda7 rustica w

2 parte om Sdgλ; opere7 eo GOWXα, operatione CJγ; quod7 que CJ, contingit add λ; per om F; exercetur7 est add y; utilitatibus7 utilitatem T; eius om fk, finem dictis imponendo docebimus add λ; et...eius om Iaε

3 De compositione quadrantis SWβ, Compositio de instrumento r, De quidditate quadrantis. Et de eiusdem formatione s, Quod sit quadrans t; formatione7 Rubrica add δ; tit om rell

(Primum D) (est igitur pars c) executura notificat primo quod sit quadrans mg Dc; Hoc executur et primo de compositione eius secundo de usu eius. dicto de compositione: ad hoc primo quod quadrans. Secundo de compositione eius. fiat igitur. diffinit ergo primo quadrantem mg K; Hic executur et primo diffinit mg b

4 partem om α; quoddam om μ

5 continens om O; per quod7 propter (stet) n; quod7 quas JLα

possumus gradum Solis et eius declinationem et stellarum altitudines accipere, horas temporis discernere, rerum altitudines, civitatum distantias, terrarum longitudinem, puteorum profunditatem invenire.

4. Fiat igitur quadrans hoc modo: accipiatur materia enea,

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1 possumus7 et quas y; Solis7 omni die add z; eius om J, Solis supralin f; altitudines7 mensurare vel add λ

2 temporis7 quotiens h; discernere7 distinguere η; rerum7 terram a; altitudines7 latitudinem in d; accipere7 et add μ

Si inequales que sunt 12 sive dies fuerit longius ut in estate (?) ut in converso? vel ad horas equales que sunt 24 non se extendit (?) (?) habere circulum? quem composui et tunc linee non serviant sed solum gradus in limbo (?) de (?) mg V; Civitatum differentias id est altitudinem poli vel distantiam cenith ab equinoctiali quod idem est mg ζ

3 distantias7 differentias BFGMRTWdklmntαβγδεζηθικλμ et add μ; terrarum7 rerum Svg, om μ, latitudinem et add y; accipere... longitudinem om P; puteorum om P, et vasorum capacitatem add y

4 accipiatur7 igitur add E βγ quidem add X, aliquod add α; enea7 vel add Idmprzγζλ, feca vel add μ

(Fiat igitur. c) Secundo (Secundum l, om D) docet (igitur D) preparationem materie et (vel Dl) tabule quadrantis (dans modus c) (Tertium l) (Docet Dl) in eo quartam (partem Dl) circuli prepositi inscribere (et lineis c) et (vel c) litteras (litteris c) insignire et (om c) limbum mg Dcl; Hoc secundo de compositione quadrantis et primo de preparatione materiae. Secundo de limitatione eius Deinde fiat: Et trahat primo de limitatione eius in grosse, secundo in speciali. Et fiat secundum mg K; Secundo disponit materiam primo grosse mg b; Alio modo et faciliori possit fieri quadrans sic fiat linea recta, deinde dividatur cum circino in 2 equalia et signetur punctus in medio. Postea aperiatur circinus plus quam esset in divisione linee et ponatur immobilis pes circini igitur aperti in extremitate linee et moveatur alius pes circulando. Deinde illud fiat in alia extremitate linee quo facto trahatur linea recta a puncto divisionis linee ad punctum ubi contingunt se duo circuli. De quibus duabus lineis potes facere rectum quadrantem mg k; Positio preparationis materiae tit r; De compositione quadrantis tit λ; De figuratione laterum et...(lacuna) tit a lignea vel auricalcea. Deinde reducatur ad formam quarte partis circuli. Deinde fiat circulus in aliqua tabula plana, cuius quarta adequetur quadranti, et illius circuli rectissime accipiatur quarta pars cum circino, et secundum illius quantitatem fiat quadrans, et infra latera quadrantis dimittatur spatium parvum ex omni parte, protrahendo duas lineas rectas constituentes angulum omnino rectum et infra angulum quadrantis; qui angulus vocetur A et fiat secundum hanc artem.

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1 lignea7 mica p, om Bλ, Et si sit lignea sit materia compacta et minime porosa add λ; vel auricalcea om mrzζλ; reducatur7 deducatur N, om E; formam om SUVgnμ; quarte partis/ quartem partem SUV

2 circuli7 sic add I;Deinde...circuli om Qq; Deinde7 Hoc modo α, Et ergo θ, om CI; fiat7 igitur add C, unius add λ; aliqua7 alia P, alia supralin s; tabula7 vel materia add γ; plana om UVoα; quarta7 pars add LIanovθμ

3 rectissime7 recte X, verissime st; accipiatur7 capiatur I, adequetur μ

4 cum7 eius T; circino7 circulo W; secundum om α, circini add K; illius7 eius y; quantitatem7 esse add d

5 et7 hoc modo α; infra7 inter T, intra Z, in aλ; latera7 limbus i; quadrantis7 diameter add T; dimittatur7 dividatur μ; parvum7 unum μ

6 protrahendo7 pro habendo o, extrahendo α, latera sive add x; duas om Jz; rectas om ν; constituentes7 continentes BJKWλ, vel continentes add β; omnino om BI

7 infra7 intra A, iuxta (a λ) aλ, sunt g, id est w; angulum7 angulus g; omnino...angulum om mr; qui7 in m, quidam add Noν angulus om BSUVdg; et^{2}7 si add δ; fiat om gn; vocetur A om μ

quadrantis7 per .11. primi Euclidis add lmr, mg DEc; hic disponit meridiem subtiliter mg b

8 et...artem om UV

5. Protrahatur una linea subtilis ab angulo quadrantis B ad angulum C, et dividatur in duas partes equales, et in puncto medie divisionis ponatur pes circini immobilis, et alius pes extendatur ad aliquem punctum iuxta A, a quo puncto tu vis protrahere lineas rectas iuxta latere quadrantis, que infra se debent includere quartam partam circuli. Extenso pede mobili circini ad illum rectum, postea secundum illum situm moveatur versus B et C et sic signetur locus in linea subtili iam protracta, ubi pes circini mobilis tangit

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1 una om RYvι κμ; linea7 recta add FLMOanyλ; subtilis om BV, id est iuxta supralin J; ab7 sub f

2 angulum7 quadrantis add OXmrzζ; et^{1}7 illa add Mu; partes om V; duas ...equales7 duo equalia U; medie7 dimidie θ

dividatur7 per 10 primi Euclidis add Lmr, mg DEcl

3 ponatur om Fμ immobilis7 in medio J; et7 in add R; pes^2 om d; extendatur7 ponatur Sg, usque add λ; ad7 in e

4 aliquem7 alium FNVv; punctum7 partem vι; iuxta7 infra H, om U; A om CUp; a om gθ; puncto om Wgα, A add f; tu om η; vis7 extrahere lineas sive add n; protrahere7 extrahere γ, duas add MQRquικ; tu... protrahere7 protrahe duas UVv; lineas7 descendentes add Z

5 a...iuxta om t; latera7 partem e; iuxta...quadrantis om UV; infra7 intra MZsvικ, inter Y, in nλ; includere7 inducere I, continere y; debent includere7 continent α

6 et alius...circini om μ; Extenso7 igitur add CQequθ; pede7 circuli add T; mobili om at; circini om B; illum7 mensuram add U, angulum add CVgyαβθ; rectum7 punctum BMOQXYZadjnqsuδη. partem I, om U; Extenso...rectum7 mobili ad directum d

7 illum7 unum (vel illum supralin) K; situm7 sit I, rectum e; postea ...situm om Cθ; B et C7 BC pes d; postea...C7 circinus volvetur et tunc scribite istum lineam subtilem iuxta .6. in una extremitate et iuxta .6. in alia extremitate α; sic om FJLSUabgknstyλ; locus7 puncta B; sic signetur7 situe μ

8 locus7 puncta B; in7 a T; subtili7 id est iuxta supralin J; iam om j; protracta7 producti I; ubi7 ut JWgk; circini om B; mobilis7 moveatur et Noν, om UVp; tangit7 transit W

illam lineam et a puncto iam dicto iuxta A usque ad punctum contactus iuxta B et C ducantur due linee, et includent infra se superius angulum rectum et inferius unam quartam partem circuli, protrahendo unam lineam circumferentialem, que contineat quartam partem rectissime unius circuli. Et illa pars inferior quadrantis, ubi est illa linea circumferentialis, vocetur limbus; et ille due alie

---

1 illam lineam7 eam SUVg; et7 si add MQuη; a7 in C. om η; iuxta^{1} om CP; A7 AD d, ut add X; contactus7 signata B, contractum (vel contactum add N) Nvyε, iam dictam P, et tactum ipsi μ

dominus Petrus de Fossis (diff. hand) mg S

2 iuxta om P, id est a add s; B7 BC λ; C7 D U, protrahantur add ce; usque...iuxta om a; a...iuxta om ν; ducantur7 protrahantur FTabyμ, situentur U, om gkt; due7 tres Zj, om gkmrt; linee om gk, recte add BGHKRYpsvικ; et^{1}7 que Cαθ, om w; includent om w; infra7 intra Zatδ, in Nλμ, C iuxta A add μ; superius7 iuxta add DEIJKLbcefiklmnrstwyz γδζθλ, iuxta A add FILa, unam quartam circuli partem iuxta add N, secundum eius supralin q; ducantur...superius om J

3 angulum om T; rectum om ci, BC supralin ζ; et inferius7 iuxta S, iuxta BC angulum rectum T, et superius j, om bcefiklmtzγζμ; inferius om DEFJLdnrwδλ, BC add K; angulum...inferius om UVg; unam om Fbfnt; partem om z; circuli7 iuxta angulum rectum et add Ugv; et...circuli om θ

4 unam om d; lineam7 rectam add PV; circumferentialem7 superficialem q, a puncto B in C add FIayμ, BC add T; circuli...partem om L

5 rectissime7 certissime dζ, recte f; unius om ι; protrahendo... circuli om C; est om N

6 illa om α; linea om g; circumferentialis7 que add α; limbus om t; ille om d; due7 linee add zλ; alie om Tiι, quadrantis add Cθ

partes extreme vocentur latera quadrantis. Et super latus quadrantis dextrum due tabule parve erunt equidistantes (56v) ab extremitatibus lateris AC; et sint perforate parvis foraminibus equidistantibus linee AC descendenti.

6. Item iuxta lineam circumferentialem inferiorem scilicet BC, protrahantur due linee circulares equedistantes inter quas dimmitantur aliqua spatia infra que describi possint in inferiori spatio iuxta limbum singuli gradus et in superiori numerus graduum, ut patebit in

---

1 partes om SVg; extreme om SVg; ille...extreme] alie due U; Et] Postea ponatur B

2 dextrum] ponantur add g; due] et ν, om o; tabule om d; parve] perforate Vg, om η, perforate add SU; erunt om BFJUVfgntvμ, fiat supralin θ; extreme...erunt] vocentur latera ε

3 lateris] alteris γ, scilicet add GOWapα; AC] ab A ad C O, A et B o, om DEFLTbcefiklmnrstyγδζλ; sint] fiat c; similiter ν; perforate] perforare ν; AC...perforate] Cum SUVg

4 AC] AB o; ab...AC om w; descendenti] deferenti β, om fnθ

5 Item] Iterum FU, Et J, Inde a, Deinde μ, om L; iuxta] infra BDEFIJLSUVabdefgimrstwzδζθλν, istam N, infra supralin q; inferiorem om SUVgi; scilicet om C

(hic c) de divisione et inscriptione limbi mg Dc; divisione limbi mg K; infra, vel iuxta mg K; hic de limbo mg b; De inscriptione sibi tit r

6 protrahantur] retrahantur a; due] et E, om d; linee om S, circumferentiales et add Nd; circulares] circumferentiales SUVgvy; equidistantes om g; inter] in μ; dimittantur] distantur μ

7 aliqua] aliquantula DEIJKLNbcdefiklmnrstwyzβγδζλ, alia R, om a; infra] inter EQ, intra GWαλ, ita O, in nγ; que] quod O, om Rj, scilicet spatia supralin J; describi] describa a, scribi fγ; possint] possunt p, debent λ; in] et a, a p, om Zoν; spatio] parte Ci

8 singuli om DEFJSTUVbcdeiklmnrtwyδζλμ; in om wη; superiori] inferiori EOZahjvwδημ, parte add nλ, loco add α; singuli... superiori] et in inferiori g; iuxta...superiori om Gp; numerus om ε; graduum] vel equa α; ut] postea add C, prius add θ

figura. Et linea inferior, scilicet CB, dividatur in duas partes equales et a puncto medie divisionis, scilicet E, usque ad A protrahatur linea recta dividens quadrantem in duas partes equales, et quelibet pars linee EB dividatur in tres, et quelibet illarum partium in alias tres. Et linee divisionum protrahantur a linea circulari inferiori

---

1 linea om S, autem add mrzζ, in add μ; inferior] superior J, in superiori g; scilicet om N; CB] EB d, AB t; duas] 3 jw, 12 v

per .29. tertii Euclidis mg l

2 equales] in puncto que sit (C sλ) add nsλ; a] in Cθ; medie] A scilicet b, om DEFJLSVdefgiklmnrtwyϒδλμ; scilicet om Bq; medie... scilicet om Tζ; E] C (singuli I) ILε', om B; medie...E] AE c; ad om Wg; A om JL

et quelibet pars linee CB dividatur in .3. et quelibet illarum partium in alias .3. et linee divisionum protrahantur ab alia circulari inferiori ad aliam circularem superiorem duo occupando spatia inter circulas continentes 18 spatia in longum inferior quoque mg q

3 equales om G; et] tamen t, ita quod v, a quo add L, a puncto divisionis add w; quelibet] utraque α, tamen add DEJUbclrwϒδ, tantum add IVefi, tunc add Skst, secunda add d, iterum add mζ

4 pars] istarum partium (linearum λ) nλ, medietas v, id est medietas supralin s; linee om Lbgλ, scilicet add θλ; EB] CB BJPSVanϒδεκ, E vel CB fμ BC scilicet BE et EC Yβ, AB X, EBC fp, om Lg, et B? E add λ, dividatur in 9 (3 IKSTd) partes (om ISTb) equales (om ISTb) in quo (hoc modo Fay, ita quod mrv, scilicet nλ, quarum Is, hoc facto μ) quelibet pars primo (postea r, om Iivwδ) (linee CB/EB v] add sv) add DEFIKNSTabcdefiklmnrstvwyϒδζλμ; dividatur om θ, primo add ILg; tres] 2 R. (duas X) partes (om u) equales (om asyz) add GIOUVWXapsuyzαβ; quelibet] iterum add mrζ; pars...quelibet om ι; illarum om UVμ; partium] pars UV, om RYικ, dividatur add SUVmrzζ; alias om UV

dividatur] per 29 (om s) tertii Euclidis add Emrsv, mg c

5 tres om z, equales add u; et...tres] in quo quelibet pars primo dividatur in 3 J; divisionum] dimensionum a; a linea] aliam ℓ; circulari] circuli a parte μ, circumferentiali d, in parte add F; et quelibet...inferiori] et protrahantur linee divisionum a linea inferiori circulari usque g

ad lineam circularem superiorem tertiam, occupando duo spatia inter circulos continentia 18 spatia.

7. Inferior quoque pars in limbo quelibet dividatur per 5 gradus equales, et protrahantur linee divisionum ab inferiori circulari linea ad aliam circularem sequentem, primum spatium occupando; et erunt 90 gradus. Tot enim debent esse in quarta cuiuslibet circuli. Et istud spatium sic distinctum per gradus vocamus limbum.

---

1 ad7 aliam add q, tertiam add α; lineam7 aliam θ; circularem om DEKTbcdeilmnrγ; superiorem om Bλ; tertiam om y; circularem... tertiam om z; occupando7 computando λ; duo7 tria ACGHPRSVWghδικ, scilicet add y; inter7 in c

2 continentia7 contenta JUalyδλ, continentes NSVagknstvwz, et erunt μ, et erunt add FIJNSUVagknstvwyδλ; 187 9 F; spatia om T, inferius (inferior nr) in limbo add DEFIJKLNSUVabcdefgiklmnstvwyzβγδζ, in longum add q.

dividatur ita quod quelibet predictarum 18 portionum sit divisa per quinque gradus equales mg q

3 Inferior7 Inferiores T; quoque pars om LTk; Inferior...pars om vμ; limbo7 ulterius add α; Inferior...limbo7 Et DEIJKLUbcdefilmnrstwyz βγδζλ; quelibet7 vero ι, illarum add E; per7 in IRWXdpvαβγθικ

inferior quoque pars mg K; De inscriptione limbi et eius divisione tit W

4 gradus7 partes nλ; et7 scilicet spatium supralin s; protrahantur7 due add o, que add xν; linee7 alie α; inferiori7 linea add q

5 aliam7 lineam FQVZaquyμ, illam O; aliam circularem7 secundam nλ; circularem7 lineam add ho; sequentem7 ad add SUVg; primum7 unum B, unum tantum n

6 occupando om g; et erunt om η; erunt7 in universo add mrζλ; 90 om μ; Tot om o; enim om oε; quarta7 parte add GJp

7 cuiuslibet om A; Tot...circuli om z; distinctum7 divisum i; per gradus om ιμ

8 vocamus7 vocabitur v, vocatur α, aluis vocatur limbus supralin s; Tot...limbum7 Hec docet inscribere circulos horarum secundum limbum c

De arte horarum invenienda

8. Consequenter dimittatur spatium ad quantitatem duorum digitorum et dimidii vel prope illud, et protrahatur linea circularis distinguens spatium inferius a superiori, et vocetur illa linea FG. Et linea illa dividatur in 6 partes equales et notentur puncta divisionum ita quod cognoscantur, et vocentur H, I, K, L, M, N. Et tunc ponatur quadrans in tabula plana, et taliter figatur cum clavis quod non moveatur de loco de facili.

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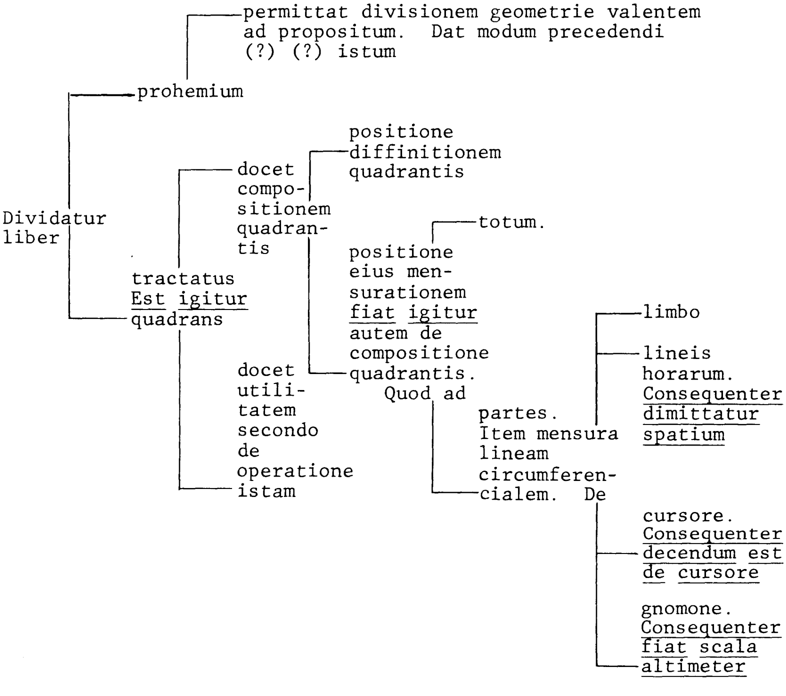
1 Tertium: De lineis horariis a, De compositione linearum horarum g, De circulis horarum mr ζ, De horis q, De inventione linearum horarum δ, tit om rell

Chart r:


permittat divisionem geometrie valentem ad propositum. Dat modum precedendi (?) (?) istum
prohemium
Dividatur liber
positione diffinitionem quadrantis
docet compositionem quadrantis
totum.
positione eius mensurationem fiat igitur autem de compositione quadrantis. Quod ad
tractatus Est igitur quadrans
limbo
lineis horarum. Consequenter dimittatur spatium
docet utilitatem secondo de operatione istam
partes. Item mensura lineam circumferencialem. De
cursore. Consequenter decendum est de cursore
gnomone. Consequenter fiat scala altimeter

2 Consequenter] Deinde θ; dimittatur] dividatur mr; ad quantitatem] a quantitate e, om Faμ, duorum] .3. κ, in latitudine supralin θ

Docet inscribere circulos horarios (Quartum l) mg DEcl; Secundo. Hic de horis lineis mg b; puncta divisionum mg z,

3 digitorum om y; et dimidii] cum dimidio UVen, om g; illum om n, Secundum instrumentrum add θ;vel...illud om μ; prope...et^2] tantum hoc C; protrahatur] una add UV; linea om f; circularis] circumferentialis y

4 spatium om Cz, scilicet add η; inferius] superius o. om DEFKLbcdefik lntwϒδμ; a] ab o; illa om BJ; linea om F; FG] F gratia exempli α

illa] per 29^m tertii Euclidis add s, (post equales) mr, mg DEcl

5 linea] ipsa mrz, om gh; illa om gkmrz; equales om Xθμ, et^2] in o; notentur/ signentur B, latera vel add y; puncta] capita η, circulariter? add θ

dividatur] per 29 tertii Euclidis add E

6 et vocentur om Xrζ, puncta divisionum add θ; puncta...vocentur om d

7 tunc] consequenter q; plana om W; taliter] tali U talis f, tabulare α, planum add Xα, supra plana et taliter supra planum add O; figatur/ figura U, figuram α, figuratur ϒε, signetur η

8 de^1] a c, in η, om ϒ; loco om ϒ, illo add Rsνικ, illo supralin K; de facili] faciliter q

9. Tunc alia tabula conjungatur ei in equali superficie in puncto C, ita quod linea AC possit protrahi in continuum et directum in illa tabula versus C. Et tunc ponetur unus pes circini in puncto A, et alius pes extendatur in linea AC extra quadrantem et queratur punctus in linea AC extra quadrantem, donec pes existens in puncto A fiat mobilis et transeat directe per puncta AH.

---

1 Tunc7 Et n; tabula om n; conjungatur7 jungatur Nu; ei om EJμ; equali7 aliquali W

2 quod7 in add x; AC7 CDG d, AS? g; protrahi7 subtrahi K, trahi h, contrahi NXt; in7 et w; et7 in η

3 illa7 secunda add β; tabula7 ab A (B add Uλ) scilicet (om FUntλμ) FJNSUVafgknstwyδλμ, versus C om α; unus om Bον; circini7 circuli κ, ipsius add U, immobilis add q; in^{2} om d

4 A7 D d; et^{1}7 ibi add Fμ, pes om fμ; extendatur7 ponatur g; AC7 A AHPTει, D d, a recte x, om COWX; extra quadrantem om n

5 in^{1}7 illa add DJSbknzδλ; linea7 alia Eceγ; AC7 DG d; extra quadrantem om nλ; in...quadrantem om Fμ; et queratur...quadrantem om BGINUVgmopqryαζκ; pes om ε, circini add JNSUVdgkstwσ; existens7 positus n; in^{2}7 illo add n; A7 illo λ, D d, om T

6 fiat...et om Fnsvλμ; directe om Tnλ; per om e; puncta7 punctum Vgw; AH7 H UV, DH d, AB gw, directe add Y

10. Consequenter queratur punctus in linea AC versus A, donec alius pes circini mobilis transeat per puncta A, I; et iterum restringatur pes circini et iterum queratur alius punctus in dicta linea versus A, donec alius pes mobilis transeat per lineam scilicet AK. Et sic fiat semper querendo punctum versus A in linea AC, donec sex linee protrahantur circumferentiales a puncto A ad sex puncta H, I, K, L, M, N. Et iste linee erunt horarum, quoniam per has accipientur hore dierum artificialum.

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1 queratur] ponatur z, alius add qα; in] eadem UVgrζ, illa λ, om WX, eadem add Smz; linea om WX; AC om DEFIJLSTUVbcdefgikmnrtwyzδζλ; A] C FJSVakntwδ C add I, donec sex linee protrahantur add λ

2 pes om b, scilicet add a; circini om nλ; transeat] AB circini w, AK α, directe add A; A om AF; I] N a, B lstvδ, D O, om Fgι; circuli add DEIJKLTbcdefilmrstvyzγζ, alterius circini add F; et iterum] deinde SUVg, om Jd

3 pes circini] circinus UV; per...circini om a; iterum om BDEIJKLSTV dimrstwzαβγζ; queratur om ι; alius om d; punctus] pes I; dicta] eadem SVg

4 versus om Qaq; A om BLXa, C add q; restringatur...donec om Fμ; alius om et; pes] circini add IWdx; mobilis om FOιμ; per om b; lineam] puncta aαθ, om b; scilicet om BCFGJNPSUVafgkmpqrstvzαδζθι; iterum restringatur...scilicet] alius pes nλ; lineam scilicet] aliam μ

5 AK] in (a N) puncto K NPSUV, AQK krtδ, et iterum per puncta (AL a) add MOa, AL add μ; fiat om n; sic fiat] fac μ; A om WYd; in om EYdγ; linea om Eyd; AC] AG d, om E

6 sex^1 om O; circumferentiales] circulares NSUV, in 6 partes equales add v; a puncto om o; A om Uy; sex om Xαλ

7 erunt] dicuntur γ, sex add nsλ; horarum] naturalium add d; has] eas θ

8 hore om a

linee scilicet inequalium mg V

De compositione cursoris in quadrante

11. Consequenter dicendum est de cursore qui sic fit; fiat quedam concavitas in spatio intercepto inter lineas circuli in limbo inferiori CB et inter lineam circularem superius que vocatur GF, et in illa concavitate situetur quedam tabula que currat et moveatur in illa concavitate a termino ad terminum. Illa igitur tabula habeat in longitudine 48 gradus in limbo; et si habeat plus, hoc erit de bene

---

1 Secundum de positione cursoris in quadrante N, De compositione cursoris et eius divisione capitulum W, 4^{m} De functione cursoris a, De cursore bmqrζ, De compositione cursoris g, De compositione cursoris et eius positione in quadrante s, De positione cursoris in quadrante. Rubric δ, tit om rell

2 Consequenter7 dicto add γ; dicendum om O; est om pu; fit om S; qui...fit7 qualiter fiat v; fiat7 sit V, om S

(Consequenter dicendum est de cursore c) hic agitur de compositione (operatione c) et ordinatione cursoris et primo de divisione eius. Secundo de inscriptione (descriptione c) signorum. (Consequenter ponenda c) Tertio de inscriptione (descriptione c) mensium (et remanent c) mg Dcl; Hec docet ponere cursorem et primo quoniam ad longitudinem mg K; Tertio. De compositione cursoris grosse et eius figuratione mg b; De cursore mg y

3 in7 et μ; quedem...spatio om R

4 inferiori om n; CB7 CD β, om BSUfgkntλ; lineam om SVg; circularem om ε; superius7 super M; que7 quod S, om mrzζ; vocatur7 nominatur n, om mrzζ; GF7 GN ACDEFPWbcefhiklostxzβε, EF X, GA μ, 6^{1} horarum add I

5 illa om α; situetur7 circuetur CGWe, ponatur I; quedam7 una α

6 illa^{1} om g; concavitate7 longitudine add L; et...concavitate om μ; situetur...concavitate om ABζλ; a7 de i, om f; termino om f; ad7 in MQZqnμ; situetur...terminum7 quaterio ad circumferentiam v; que ...tabula om α; habeat7 tantum add MNQZjqην

illegible note mg K; terminum7 In latitudine autem dividatur in 4 partes equales add j

7 longitudine7 longum UV, tantum add o; gradus om X; in limbo7 limbi mrzζ, om h; si7 non γ, om eo; erit om Gpv; de7 ad λ

esse cursoris et non deesse.

12. In latitudine autem dividatur in 4 partes equales cum quibusdam lineis circularibus, et quelibet quarta in 3 partes equales, et erunt omnes 12.

13. Consequenter longitudo cursoris dividatur in 2 partes equales per lineam rectam protractam per totam longitudinem equidistantem ab extremis. Et sit extremitas cursoris dextra P,

---

1 cursoris om d; deesse] cursoris add RY

deesse] some portion of an unknown text dealing with the drawing of the hour lines in the quadrant and related material add (f. 120r-v); the folio is two-thirds the size of the remaining folios and is obviously bound with the manuscript by mistake n

2 In] que currat add e; autem om Rdnλμ; dividatur] primo add I; 4] 12 DMSTUVcefgklmnrswyzδς, 2 ELtλμ; equales om I; cum om mrz

3 circularibus] sex add y; quelibet] illarum add α; 3] 4 κ; partes] quartes x, om α

4 equales] inequales ACMNOPQZoqxαβεην, dividatur add v; quarta...12] illarum (in alias 2 et erunt L) quatuor (partes equales; tunc iterum quelibet illorum L) dividatur in 3 (partes inequales L) (et sic sunt 12 partes equales I) IL; et quelibet...12 om DEFKSTUVcdefgiklmnrstwy zγδςλμ

5 longitude] enim add q, solis add μ; cursoris om UVgk; 2] tres ε

Hec quoniam ad latitudinem mg K

6 equales om ι; et erunt...equales om Y; in 4 partes...equales] in 12 partes inequales et dividatur J; rectam om λ; protractam om L; longitudinem] latitudinem FLafwyδμ, superficiem latitudinis n, et latitudinem supralin s, tam distincta add μ

ponatur in capite Arietis mg l

7 ab] ex add Y; extremis] vocetur add p; sit] vocetur Cθ, om BFαμ; extremitas] contrimitas et cetera ut illud. Vide ulterius nihil deest: (one and one-half folios blank) Et sit contrimitas L; dextra] vocetur add Bβ; P] U α, om t

et sinistra S. Et linea media vocetur QR; ita quod superius sit Q et inferius R.

14. Tunc sciendum est quod tria spatia inferiora in latitudine cursoris et (57r) 3 spatia superiora continebunt duas medietates zodiaci cum signis et gradibus et numero graduum; et sex spatia intermedia continebunt duas medietates anni cum mensibus et diebus et numero dierum; que quidem 2 medietates anni respondent 2

---

1 et^{1}7 in add μ; S7 G (vel S supralin N) Nβμ, sit α, R ε, G add F; media7 que add NSUVg; QR7 Q Uε, Q scilicet X; ita7 in M, om R; sit om Gp; Q7 quod O

2 inferius7 sit add Jiu; ita...inferius7 quod superius δ; R7 S X, T o, Q p, P ε, ut patet in figura add n

3 sciendum7 istud p; est om CGHORWYhpvxθικ; quod om F; Tunc...quod7 Et J; in om n; latitudine7 latere Y, longitudine Υ, om n

Distinguit spatia cursoris mg k; spatia7 nota cum quod multi cursores habentes sicut signa in spatiis intermedius et menses et numeros in externus spatiis tam superioribus quam inferioribus mg a

4 spatia om BUamrvzζλ; duas7 tres k δ; medietates7 anni add UV

spatia7 break in text of 16 blank lines T

5 cum7 et v; signis7 zodiaci add n; et^{1}7 in η, om UVh; gradibus om UV; sex7 9 p, tria q, octo y; spatia7 signa tδ, signa add k; et^3...spatia om I

6 intermedia7 numero add I; zodiaci...medietates om Nwμ; cum7 a u, et v, om Q

Hec quod quadrans que hodie fuerit non fuerit secundum canonem? istum quia secundum istum canonem? signa de (?) (?) in 3 spatiis superioribus et in 3 inferioribus partibus? primo est mensis secundo est dierum mensium numerus et in tertia spatia. In (?) (?) totu situ perponatur menses et dies mensium in omnibus spatiis superioribus et in omnibus inferioribus partibus? ponendo primi menses, postea numerum dierum, postea dies, postea signa, postea (?) (?) et postea signa mg K

7 que7 et J, De K; quidem7 hoc J; 27 alia z

medietatibus zodiaci. Nam in una medietate anni movetur Sol per unam medietatem zodiaci et in alia per aliam. Et ita istis 2 medietatibus respondent 6 inferiora spatia et 6 superiora.

15. Consequenter incipiendum est ponere signa in tribus spatiis inferioribus et in tribus superioribus et primo incipiendum est ponere Arietem in tribus lineis inferioribus iuxta lineam mediam QR versus P. Et ponatur linea media cursoris super principium

---

1 zodiaci7 om Jt, cum signis (para. 14. 1. 3)... zodiaci add μ; anni om Jαε

zodiaci7 secundum quod sol movetur (moretur s) in illis duabus medietatibus add sv, mg K

2 deesse (paragraph 11)...unam om (one-half of folio cut out) b; medietatem/ aliis medietatibus add ktwδ; Nam...zodiaci om i; in om ε; alia om ε, medietate add λ; zodiaci...alia7 Aliis medietatibus zodiaci vocatur J; aliam7 illam e; istis om Y; ita...27 in illas Π

3 respondent7 tunc erunt J, om ȝ, scilicet add n; spatia om a; 6^{2}7 9 p; superiora7 aliis duabus medietatibus add v; Et...superiora om B

4 Consequenter7 etiam add f; est om v; incipiendum...ponere7 ponenda sunt mrzζ; tribus7 4 ι, om n; spatiis om a

Hec docet D) de positione et situatione signorum in cursore mg Dcl; Aliis 2^{bus} medietatibus. Hec docet locare signa mg K; Hec de inscriptione specialiter et primo signorum. Secundo mensium mg b; (Quintum a) De positione signorum in cursore tit aδ

5 inferioribus om AT; spatiis...et^{1} om R; in om BYmrzκ; tribus om n, spatiis add DFIJKNceiklstμ; et...tribus om PT; superioribus/ spatiis add f; et^{2}7 in κ; incipiendum7 dictum o, om mrzζ; est om TWmrzζ

6 ponere om hmrzζ; et primo...ponere7 in primi ponendum est i; Arietem om ACGHOPRXYahpειкλ; tribus7 tertia NSUV, duabus γ, om n, Arietem in tribus om μ; lineis7 linea NSUV, spatiis Bmrzλ, om i, id est spatiis supralin a; inferioribus...lineis om δ; inferioribus7 inferiori NSUVg, superioribus mr; mediam om JRYmrβικ

7 QR/ QS X, Q ε; P7 R X, SP y; ponatur7 in add ν; linea7 break in text of six blank lines e; super7 versus FHμ, sicut u

alicuius gradus in limbo et computentur 11 gradus et dimidius in limbo, quia tanta est declinatio Solis in Ariete; et in fine 11 gradus et dimidii ponatur una pars regule et alia pars supra punctum A, et protrahatur una linea recta occupans tria spatia inferiora et tria superiora, et ista spatia respondent duobus signis, inferius Arieti et superius Virgini.

16. Postea a fine 11 graduum et dimidii computentur gradus 8 et dimidius, et ibi ponatur regula sicut prius, et protrahatur

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1 gradus^{1} *om* *h*; 11] duos *DFLmvμ*, 13 *I*, tres *γ*; gradus^{2} *om* *f*; in... gradus^{2} *om* *R*; dimidius] 32 minuta *g*; et dimidius] cum dimidio *ayμ*; in...dimidius] duodecim gradus et *U*

2 in limbo *om* *gθ*; quia] QR *y*; est *om* *ε*; in^{1} *om* *s*; Ariete] fine Arietis *MOQZgjuη*, *om* *s*; fine] igitur *add* *s*; et...fine] scilicet *g*; 11] duo *mvxy*, secundus *γμ*

3 dimidii *om* *U*, Postea *add* *g*; una pars] regula super finem 11 gradus et dimidii *g*; regule] recte *ε*, infra *η*; pars^{2} *om* *SVαι*; punctum] primum *add* *N*, puncti DA *add* *o*

4 A *om* *X*; trahatur *RYικ*; recta *om* *bz*; tria *om* *n*

5 tria *om* *n*, spatia *add* *GTp*; tria...et *om* *C*; ista] alia *d*; spatia] tria *add* *DEFIJKSTUVcdefgiklmtwzβδζλμ*, 2 *add* *Lnγ*, 6 *add* *h*; respondent] corespondent *α*, erunt *J*; duobus] 3 *ISUVε*, *om* *ν*; signis] scilicet *add* *MQZjuαη*

6 superius] in *add* *n*

7 Postea] et *UV*; a] in *Jγ*; 11] duorum *mvxyγ*; gradus *om* *MQUjuη*; 8] 9 *p*, 3 *v*

de positione Tauri et Leonis *mg* *h*

8 computentur...dimidius *om* *X*; et dimidius *om* *μ*; ibi] si *X*, ita *hv*, in *p*, *om* *wβ*; sicut] ut *Iα*

linea in tribus inferioribus spatiis et in tribus superioribus; et erunt 2 spatia aliorum 2 signorum, scilicet Tauri et Leonis, quoniam illorum eadem erit declinatio.

17. Et tunc in fine cursoris versus P inter lineas iam protractas et illum finem erunt spatia 2 signorum scilicet Geminorum et Cancri.

18. Consequenter fiat divisio alia in alia parte cursoris S, ita quod primo dimittatur spatium 11 graduum et dimidii inferius et

---

1 inferioribus7 superioribus v; spatiis om B; et^{1}7 etiam a; in^{2} om Bη; in tribus^{2} om μ; in superioribus7 occupans etiam spatium inferius et spatium superius n, sicut prius add μ

2 erunt7 tunc θ; 2^{1}7 3 AWoν, om α; aliorum om μ; 2^{2} om n; scilicet7 qui p, om j

erunt 4 gradus fere pro declinatione Geminorum et Cancri mg c

3 illorum7 eorum Xnwyδ, tantum add θ; eadem om j

4 P om γ; inter7 illas add Vv; iam om v

de positione Germinorum mg h

5 et^{1}7 in add Wp, versus add k, iuxta add ε; finem7 partem g; et^{1}... finem om s; erunt om γ, (alia L) duo add IJKLSUcefgquwzβγδ; spatia om Dit, aliorum add Un; Tauri...scilicet om μ; scilicet om q; Cancri7 Tauri i, quoniam illorum eadem est declinatio add UV; spatia... Cancri om d

erunt7 (erunt Ml) scilicet (om d) 4 gradus fere pro declinatione Geminorum (om r) et Cancri (om Er) add Edmrζλ, mg Ml

6 alia^{1} om Bdo; cursoris7 versus add Yα, a media linea QR add I, ita add μ, scilicet add ζλ; S7 scilicet versus A MQ scilicet n, A q, om BCSUVgmrwzδζ

S7 a linea media (intra j) QR versus aliam (om s) partem (om s) cursoris (om s) S (scilicet Q v, om K) add Zjsvη, mg K; de positione signorum zodiaci? et primo Pisces inferius?. Secundo Aquarius inferius?. Item de positione Capricorni inferius?. Postea mg h

7 ita om o; quod om l; dimittatur7 accipiatur B, dividatur Yλ, primo add a, .11. add α; 11/ duorum Fmoxγν, 5 v, 3 μ, om O; dimidii7 cum dimidio S, aliud add nλ, unum add v

aliud superius. Et in istis 2 spatiis scribantur 2 signa, Pisces inferius et Libra superius.

19. Postea dividantur alia 2 spatia secundum quantitatem 8 graduum et dimidii in quibus ponantur alia 2 signa, Aquarius inferius et Scorpius superius.

---

1 in *om Xa*; istis] inferius *X*; 2^1 *om fn*, signis *add λ*; spatiis *om mry*; scribantur] erunt *mrζ*, *om z*; 2^2 *om Lnλ*; signa] et *add f*; Pisces] scilicet *add f*

2 regule (*paragraph 15*)...Libra *om* (*folio cut*; *cf. paragraph 14*) *b*

3 Postea...quantitatem] (Postea *lmzζλ*) item (alia duo signa *mzζλ*) (ponatur *ζλ*) in duobus (*om mζλ*) spatiis *ABCDEFGHKOPRTWXZabcdehlmopwxyzβδεζϑικλν*; dividantur] dimittantur *QZgqsuη*, *om NUVfknrtγ*; spatia] signa (in spatiis *r*) *Vr*; secundum quantitatem *om nr*; 8] 9 *p*

Primo Aquarii et Scorpionis *mg h*

4 et dimidii *om X*; quibus] quo *Zjlquη*; in quibus *om ABCDEFGHKLOPRTWXYabcdehklmoprwxyzβδεζθικν* ponantur] scribantur *JNSUVfgknstvγλ*; signa *om wδ*, scilicet *add BCLUVfnstγθλν*; ponantur...signa] scilicet *mrzζ*; Postea...signa] Item alia duo signa scilicet *α*; inferius *om UV*

5 superius *om UV*; inferius...superius *om e*; Postea...superius *om Ii*

20. Postea in 2 spatiis remanentibus in fine versus S, ponantur alia 2 signa remanentia, scilicet Capricornus inferius et Sagittarius superius.

21. Et quodlibet spatium de tribus inferioribus spatiis respondentibus signis dividatur unum per 3 partes secundum per 30. ita quod gradus scribantur inferius et numerus graduum superius, et super numerum graduum nomina signorum; et erunt tria spatia inferiora occupata et tria superiora.

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1 Postea7 Et NSUVfgkntγθλ, Eandem et mrzζ; in^{1} om LWδ; S7 6 L, E Z; in^{1}...S7 in ultimis (istis fg) duobus (om d) spatiis (om d) (superioribus d) JSUVdfgknstγθλ, alia duo spatia secundum quantitatem quatuor (duorum? y) (et dimidii F) in quibus (qualibet y) Fy, om DETbceimrwzβζ; ponantur7 scribantur FJLSUVafgknstvyγθλ, om DET bceilwβ

Primo de inscriptione Capicorni et Sagittarii mg h

2 alia om CGOWX; spatiis...2 om δ; Pisces (par. 18, 1. 3)...signa om μ; signa om γ; remanentia7 residua v, in fine usque add θ; scilicet om qyμ; Capricornus7 Scorpius f; Scorpius...et om p

remanentia7 vel sic. Item in duobus spatiis octo graduum et dimidii ponantur alia duo signa scilicet Aquarius inferius et Scorpius superius. Postea alia duo signa remanentia add γ

3 superius om ε

4 quodlibet7 om B, signum add μ; spatium om B; tribus7 sex nλ, duobus p; inferioribus om Bε, et superioribus add nλ; spatiis om SUVz

de? gradibus? signorum (et de nomina signorum?) potest fieri (seam) mg h

5 dividatur7 per 30 gradus add V; unum7 duorum remanentium per add B; per^{1}7 in α; 37 30 x, 2 ι; partes7 equales add α; secundum7 et reliquum α, in latitudine et longitudine add θ; unum...secundum del q; per^{2}7 in α; 307 3 x, gradus add KMQSZajpquηθ; unum...307 per 30 gradus DEFIJLTUbcdefgiklmnrstwyzβγδζλμ, per partes 6 per 30 v

6 ita7 in d, om α; quod7 que α

7 super7 post g; numerum7 nomina V; nomina signorum7 signa μ; et^{2}7 sic add α; tria7 nomina V, om β

8 inferiora7 in Libra β, om η; et tria om w; occupata...superiora om ι

22. Et remanent 6 spatia intermedia in quibus scribantur 12 menses. Hoc autem fiat hoc modo: vdeatur in tabula in quo gradu Capricornii incipiat Januarius, et super illum gradum ponatur regula et super punctum A, et protrahatur una linea, tria spatia occupando que sunt supra tria spatia inferiora.

23. Postea videatur in eadem tabula in quo gradu Aquarii incipit Februarius, et super illum gradum ponatur unum caput regule

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1 Et] tunc supralin q; remanent] remanebunt a, ergo add nλ; 6 om U; 12] 13 R, 22 v

Hec dat (docet c) modum locandi menses in cursore et primo simplicem circularium linearum incriptionem secundo mensium nominum dierum et (in c) numeri (numero c) eorum insignationem (intitulationem c) mg Dl (at paragraph 18) c; De scriptione quorum mensium et sicut prius. a Hec dicat inferior mensium mg K; hic secundo de inscriptione mensium mg b; illegible note due to seam h; quomodo Januarius inscribitur mg Dl; De spatiis intermediis in cursore mg z; De inscriptione mensium mg θ; Consequentur dicendum est de cursore: (1) de divisione eius, (2) de inscriptione consequenter ponenda; de inscriptione: signorum, mensium et remanent 6 spatia mg r; Sextum: De positione mensium in cursore tit a

2 autem om ep, modo add X; in^1 om CJ; tabula om C, parvula (parva z) subscripta add mrzζ; in^2 om vκ; gradu] videatur add d

Primo de prius termino Januarii extra (?) mg h

3 Januarius om J, in tabula add C: illum om ε

4 super om mrζ; punctum] spatium η; A] inferius et Scorpius superius add e; una] alia nλ; linea] recta add g, ista add nλ

5 occupando] occupans B; sunt om m, tria add j; supra] superiora z, om vβικ; que...supra] inferiora g, om λ; spatia om S, aliud add C; que...spatia om B

que sunt supra et tria spatia mg g

6 Postea] Primo μ; in^1] de θ, illa add wδ; in^1...tabula om g; in^2... gradu om R

de tertio in fine mg h

7 et super] conveniens? w; gradum] locum B, et punctum (super α) A add mzαζ; ponatur om q; unum om Xamrvzαζ; caput om Umrzαβζ; regule] regula mrzα, extremum illius U

et aliud caput super punctum A; protrahatur alia linea occupando ista 3 spatia eadem. Et in spatio intercepto inter illas duas lineas protractas per illa tria spatia scribatur Januarius in superiori spatio illorum trium, et in inferiori ponantur dies mensis Januarii et in spatio medio numerus dierum.

24. Unde videndum est si mensis habeat 30 dies; tunc dividatur in 6 partes equales, et quodlibet spatium dividatur in 5 dies,

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1 aliud om mr; caput om Kfdgmr, regule add B; super om cmr; punctum om μ; A om f; (et αζ) aliud...A om zαζ; protrahatur] quod add APRYZuηιμ, quibus add HQj, una add h; alia om Baμ; ista om Bmrz

2 eadem] in spatia eadem add e; Postea...eadem om λ; que sunt (paragraph 23)....eadem om n; intercepto om mrμ; inter om z; illas om hzη; duas] tres γ, om nλ; lineas] iam add UVv

3 duas...illa om R; tria] duo nν, om UV; per...spatia om g; superiori] inferiori BLq

4 spatio om t; trium om g; in om Jafwν; inferiori] superiori B; mensis] dies add ITcei

(ubi menses l) ubi dies mensis, ubi numerus dierum (eius mrζ) mg lmrζ

5 spatio om Xα; medio] intermedio NSTUVbcegk, om δ; dierum om X; et...dierum om nλ

6 Unde] Deinde μι; est om KXvκ; si] utrum i; mensis om m; habeat om O; dies] semper si sic Q, om B, quod (om u) si sic (est q) add MZjqu

Primo de inscriptione nominis et numero dierum Januarii et de divisione eius in dies mg h

7 partes equales] per equales spatia η; spatium] partium B, om UV; dividatur] distinguatur wδ, om Xhm; dies] partes X, om MQUZdqη

et erunt 30. Si vero mensis contineat 31 dies, tunc primo dimittatur spatium unius diei secundum estimationem propinquam veritati, et residuum spatium dividatur in 6 spatia, et quodlibet illorum 6 in 5, sicut prius.

25. Consequenter videatur in tabula in quo gradu Piscium incipit Marcius, et super illum (57v) gradum et super A ponatur regula, et protrahatur linea sicut prius, et erit spatium in quo scribetur

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1 erunt *om* *ν*; 30] dies *add* *a*; vero] autem *η*, *om* *Bι*; contineat] obtineat *T*, habeat *g*; dies *om* *X*, spatium *add* *T*; dimittatur] dividatur *λ*, addatur *add* *θ*

2 spatium] numeri *add* *T*, primo *add* *c*; diei] in fine *add* *I*; estimationem] predictum *add* *y*

3 spatium *om* *OXagy*; spatia] partes equales *μ*, *om* *g*; illorum *om* *g*, dividatur *add* *λ*; 6^2 *om* *BIXgsκλμ*

4 sicut] ut *mz*, quod *μ*, *om* *B*; prius *om* *B*

prius] Continenter videatur in tabula in quoto gradu Aquarii incipit Februarius et super illum gradum et super punctum A ponatur regula et inde protrahatur linea sicut prius et habebis spatium in quo scribetur Januarius et linea modo protracta erit principium Februarii (*variation of paragraph 23*) *add* *n*

5 Consequenter] Continenter et enim *n*; videatur] videndum est *av*; tabula] eadem *add* *EKLTceimwyzβγδζ*; in^2 *om* *A*; quo *om* *e*; gradu] si *add* *T*; Piscium] spatium *o*, *om* *μ*; incipit *om* *μ*

(scilicet *c*) quomodo Marcius (inscribitur *c*) *mg* *Dcl*; *de inscriptione Marcii* *mg* *h*; September November Junius Aprilis triginta dato; relique magis uno, si (sive *l*) sit bissextus Februarius minor est duobus *mg* *Dl*

6 gradum] ponatur *add* *ι*; super^2] punctum *EIKLTceimqrβγζ*, punctum *add* *JNQUVdghknstwyδλ*; illum...super^2 *om* *y*; ponatur] posita *ITceimryzζ*; et^3] inde *add* *λ*

7 protrahatur] una *add* *h*; linea] regula *N*, *om* *d*; sicut] ut *Iimryζ*, *om* *z*; prius *om* *z*; Consequenter...prius *repeated* *G*; erit] aliud *add* *θ*

Februarius, qui solus 28 dies habet. Unde potest dividi in 4 spatia equalia, quorum quodlibet tenet 7 dies.

26. Postea videatur in quo gradu Arietis incipit Aprilis, et ponatur regula sicut prius et erit spatium Marcii cum diebus et numero dierum.

27. Postea fiat ita de omnibus aliis mensibus. Et sciendum quod December et Junius debent scribi ita quod una medietas illorum

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1 solus7 qui add β ; habet7 continet o ; Unde om nλ ; dividi7 in 28 dies scilicet add g; 47 partes add X

qui solus diviso 28 mg c; de inscriptione Februarii mg h; Dicit 28 dierum Februarii mg l; Unde sciendum est quod Februarius 28 habet aut 29 dies mg ζ

2 tenet7 continet CGOSVWXYabdgnpqsαμ ; dies7 et illa linea erit principium Marcii add n

3 gradu7 signi add I; Arietis om ft

quomodo Aprilis mg Dcl

4 et ponatur om d; ponatur regula7 protrahatur linea ILimrzγζ ; sicut7 ut mr; et^{1}7in d; erit om F; spatium7 in quo add cμ ; Marcii7 in quo scribatur Marcius DEFJKNSTUVabefgklnstwβγδζλ, om Oy

5 dierum7 et illa linea erit principium Aprilis add n; et erit... dierum om Iimrz; ponatur...dierum7 protrahatur linea sicut prius L

dierum7 (Et ckln) Postea ponatur regula (alia J, om λ) super (supra ckl) gradum (gradus ckl) Arietis (Tauri TUVdgnλ) (ubi vel γ) in quo incipit Aprilis (Maius TUVdgn λ) et (diende μ) protrahatur linea sicut prius add DEFJKSTUVbcdefgklnstuwyγδζλμ, mg q

6 Postea7 Et g; fiat7 sciatur Y; ita om i; aliis om dvιλ ; Et7 aut R; sciendum 7 istud p, est add NUqswδ

quomodo December et Junius (inscribuntur l) mg cl; illegible note (seam) h; (de positione?) notabilitate et primo de inscriptione Decembris et Junii et tantum eius. Et sicut de inscriptione mensium superiorem (et inferiorem?) mg h

7 scribi ita om X; de...ita om L; una om β ; medietas7 dimidietas i; illorum7 de add S

scribatur inferius in medietate inferiori et alia medietas in medietate superiori, ad significandum quod in duabus medietatibus 2 illorum mensium ascendit Sol in zodiaco et in duabus descendit. Et (58r) sicut scribuntur menses in parte inferiori cursoris, ita scribantur in parte superiori.

28. Et si quadrans est magne quantitatis, tot sint spatia sub mensibus quot sunt dies in mense, ut tamen linee continentes quinos

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1 scribatur om ων; inferius om BU; medietate] medio g; inferiori] superiori a; medietas] dimidietas i, om ι

2 medietate] medio g; inferiori...medietate om η; ad om n; significandum] designandum Bqtλ, signandum OUiswxyαβγδει, insignandum T, assignando n, gradum μ; quod om λ; duabus] 3 Pp, illis UV; medietatibus om wδ, anni add t; 2] 3 P, om θ

ad significandum quod eodem modo alii menses 6 superius (in parte superiori D) inscribuntur mg Dc

3 Sol om a; in zodiaco om z; in^{2}] aliis add CJMNSUVZgjkqstuwδηθ; duabus] secunda m ζ, tribus o ν, medietatibus add JSVgksvw δ, aliis add nαλ; descendit] ascendit QW

vel in duabus mg ζ

4 sicut om V; scribuntur] inscribuntur ci, om U; menses]etiam add n; inferiori/ superiori n, quadrantis vel add d; cursoris om Zλ; ita/

5 in parte om df; ita...superiori om AZn

quomodo inscribendum est in magno vel parvo quadrante mg c; Nota ad habendum numerum stabilem altitudinis capitis Arietis in qualibet regione consideretur locus? poli super orizontem. Et quot gradibus elevatur tot subtrahas a 90; residuus numerus stabilis id est altitude capitis Arietis in illa regione et ille est addenda vel ab ea subtrahenda. Declinatio tot inventa in tabulis et erit altitudo solis in Ariete mg g

6 est] cum w, ita add JSUVgknstλ; quantitatis] quod add SUVg, Ut add nλ; tot] tunc Tx; sint om JY; spatia] vel puncta add Gp; sub] in ν

Hec interponatur quadrans tit l

7 mensibus] ponatur add Y; sunt om Bd; dies om v; mense] anno Boν, scribantur add λ; ut] aut C, et TXntΥλ,enim w, Ita α, om dp θ, si add y; tamen] novem q, si y, om CnΥλ, quod add α; quinos] 28 g

dies vel 6 vel 7 protrahantur occupando duo spatia, ut melius scribantur numeri dierum et distinguantur inter se. Et linee distinguentes dies non occupent nisi unum spatium. Si autem quadrans non fuerit magne quantitatis, ponatur unum spatium pro 2 diebus vel 3, secundum possibilitatem quantitatis cursoris. Et hec de cursore dicta sufficiant.

29. Hec tabula docet in quo loco sit Sol in initiis mensium, hoc est, antequam aliquid istorum sit pertransitum; et hoc ideo ut

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1 dies] decem α, om Imz, quibus add μ; vel^1 om Cα; 6] 30 g, om C; 7] 8 JSUVkntwδλ, 31 g, secundum quod requirunt menses add g; protrahantur] habentur y, linee add g; duo] 3 Iaγμ, om nε; ut] et βδ; melius] videantur (et λ) add nλ

2 et^1] vel H

3 dies] se λ; dies...occupent om C; spatium om SUVjgk

quando sit si quadrans parvus sit tunc ponantur spatia graduum maioris quantitatis mg D

4 quantitatis om v; ponatur om θ; unum] ibi v, om W; spatium om UXhα; pro] in λ; 2] 3 pν, om wδ, partibus add sv; diebus om dg; vel] pro add gv

5 3] ut add o, diebus add wδ; quantitatis] quadrantis (et JNSVkstwδ, vel g) HJKNSVgiknstwβγδλ, om IX, quadrantis add e, ponatur unum spatium add θ; ponatur...quantitatis om O; cursoris om Hnλ

6 dicta om uμ; sufficiant] sufficiebant a; Et...sufficiant om λ

7 Hec] Item z, sequens α, precedens add RYικ, autem add v; tabula] que ponitur iuxta quadrantem add q, stans post figuram quadrantis add z; docet] scire add o; in^2 om CGKOehp

quam videre poteris infra ad cartam 78 mg q; De tabula stans post figuram quadrantis mg z

8 hoc^1] autem add IOV; est om Vv; aliquid] ad θ; antequam aliquid] quoniam de aliquo (stet) B; istorum] signorum add B; sit om m; pertransitum] transitum SVθ; ideo] omnino T

sciatur primus tractatus initiorum mensium in astrolabio et quadrante secundum hos gradus pertransitos.

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1 sciatur] prius *add* *T*; tractatus] introitus *mr*, terminus *u*, *om* *v*; initiorum] minorum *S*; in] ut *a*, astrologia vel *add* *θ*

2 hos *om* *θ*; pertransitos *om* *a*, sicut prius in quadrante *add* *ζ*, et cetera *add* *θ*; hoc est...pertransitos *om* (*paragraph* *22*, *mg*) *J*; Hec...pertransitos] *follows table* *BDNSV*, *paragraph* *31*, *l.* *9* *h*, *paragraph* *87*, *l.* *3* *l*, *om* *AFNUdfgktwyβδλμ*

Initia dierum mensium	Signa	Grad.	Min.
Initium primi diei Marcii	Pisces	16	53
-- Aprilis	Aries	17	35
-- Maii	Taurus	16	13
-- Junii	Gemini	16	47
-- Julii	Cancer	14	27
-- Augusti	Leo	14	0
-- Septembris	Virgo	14	35
-- Octobris	Libra	14	13
-- Novembris	Scorpius	15	30
-- Decembris	Arcitenens	15	52
-- Januarii	Capricornus	17	34
-- Februarii	Aquarius	18	53

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1 Tabula ad sciendum in quo loco sit sol in initiis mensium accepta ab almanac anni 1299 tit A, Initium mensium tit B, Tabula initiorum signorum in mensibus tit H, Septimum: De lateribus umbre tit a, Hec docet componere scalam altimetram tit l, Tabula gradus Solis in initiis 12 mensium tit β, Hec tabula docet in quo gradu signi sit Sol in initiis mensium tit δ, (?) hec tabula ad sciendum initia dierum mensium in signis tit θ; Hoc dat compositionem scale altimetre mg c

2 Pisces7 16 53 (initium primi diei signi) add t; 16 537 18 19 A, 18 6 B, 19 0 H, 17 53 t, 16 43 43 (sec.) k, 53 sec. add J

3 Aries7 17 36 add t; 17 357 18 48 A, 18 33 B, 19 30 H, 17 36 35 (sec.) Jk

4 Taurus7 16 35 add t; 16 137 17 46 A, 17 31 B, 18 26 H, 16 35 13 (sec.) J, 16 34 13 (sec.) k

5 Gemini7 16 13 add t; 16 477 17 25 A, 17 6 B, 18 4 H, 16 13 47 (sec.) Jk

6 Cancer7 14 47 add t;14 277 15 59 A, 15 37 B, 16 40 H, 14 37 OSVa, 17 20 y, 14 47 20(sec.) Jk

7 Leo7 14 27 add t; 14 07 15 51 A, 15 14 B, 16 22 H, 14 30 OSVa, 17 0 y, 14 27 0 (sec.) Jk

8 Virgo] 14 35 *add t*; 14 35] 15 46 *A*, 15 14 *B*, 16 27 *H*, 17 35 *y*, 14 14 *ν*, 30 sec. *add Jk*

9 Libra] 14 11 *add t*; 14 13] 15 25 *A*, 14 51 *B*, 16 5 *H*, 15 36 *OSV*, 17 13 *y*, 14 12 13 (*sec*.) *Jk*, 14 35 *ν*

10 Scorpius] 15 20 *add t*; 15 30] 16 32 *A*, 15 58 *B*, 17 14 *H*, 18 30 *y*, 15 20 30 (*sec*.) *Jk*

11 Arcitenens] 15 21 *add t*; 15 52] 17 2 *A*, 16 33 *B*, 17 44 *H*, 18 52 *y*, 15 51 52 (*sec*.) *Jk*

12 Capricornus] 17 25 *add t*; 17 34] 18 41 *A*, 18 17 *B*, 19 22 *H*, 17 24 *t*, 20 28 *y*, 17 28 24 (*sec*.) *Jk*, 17 28 *ν*

13 Aquarius] 18 51 *add t*; 18 53] 20 6 *A*, 20 3 B, 20 47 *H*, 22 53 *y*, 53 (*sec*) *add Jk*

Variations of 2 or 3 digits in chart KLOWXacsδ; *additional chart with readings at five-day intervals*, *ν*; *unrelated material add αθ*; *table inserted paragraph 22*, *l*. *2 J*, *para*. *28*, *l*. *2 O*, *para*. *31*, *l*. *9 Sh*, *para*. *87*, *l*. *3*, para. *24*, *l*. *6 o*, *om MNPQRTUVdjpuvwηκλμ*

Sequitur de scala altimetria

30. Consequenter fiat scala altimetria sicut patet in quadrante, et fiat sic; linea AK, que est ab A usque ad cursorem, si quadrans cursorem habeat, vel ab A usque ad K, si non habeat cursorem, dividatur in 2 partes. Et in puncto medie divisionis ponatur pes circini immobilis, et alius pes extendatur usque ad punctum in angulo iuxta A; et tunc ille pes mobilis secundum situm in quo tetigerit dictum punctum, motu suo signet duo puncta in lineis

---

1 De compositione scale altimetra Ws; 7^{m} De lateribus umbre a; De quadrato mr; Sequitur om bq; tit om rell

2 scala] tabula η; altimetria om P; sicut...quadrante om B

Hec docet componere scalam altimetram mg D; (Quarto b) de scala altimetra mg bz; Hoc dat compositionem scale altimetre mg c; (?) ultimo? de inscriptione scale altimetre et primo de (?). Secundo (?). Et primo de inscriptione et de divisione eorum (?) utraque linea mg h

3 tractatus (paragraph 29, l. 3)...et om p; sicut...fiat om LTceimrzζ; sic] secundum ut add g, sit add kwδ; AK] altimetria K X, AQ t; est om β; ab A] AB f; ad om c

4 cursorem om L; si...habeat om a; vel] et K, ut β; ab] a QUg; ad] A p, om W; K] lineam circumferentialem superiorem B, R Os, S X, limbum add MQZju; si] quadrans add a, vero add λ; si...cursorem om dθ

5 2] 3 I; partes] equales add BMNQUVWZhlnoqsuηλ; Et] tunc add v; ponatur] unus add UV

per .21. primi Euclidis mg l

6 circini] circuli f; immobilis] mobilis β; pes om ITUceimyζ; et... pes om β; usque om qμ; ad om z; punctum om z, AH add λ

7 iuxta om Ugh; in...iuxta om n; A om hv; pes om X; mobilis] immobilis Pi; secundum om z, illum add U; situm] motum SUVg; in] si i; quo om Tcei

8 tetigerit] tetigit a, cotingerit v, tangit λ; dictum] Deinde β om αε; suo om β; signet] significet X, signentur Y, signabit λ; duo om T

descendentibus iuxta latera quadrantis et a puncto K, si est cursor, vel in contactu linee medie cum superiori circumferentiali linea in limbo, si non est cursor, protrahantur due linee recte, et iuxta illas alie due occupantes 2 spatia.

31. Et utraque linea dividatur in 12 partes equales, et protrahantur linee illas divisiones designantes. Et spatia inter lineas ex utraque parte intercepta dicuntur puncta, et scribuntur superius numeri punctorum incipiendo a lateribus quadrantis

---

1 descendentibus] ascendentibus *Mu*, *om* *λ*; puncto] scilicet *add* *λ*; K] Q *Rs*; si...cursor *om* *Fμ*

2 vel] et *nλ*, *om* *JNSUbfgkot*; in] a *BMYjuη*, *om* *aδ*; medie *om* *z*; cum] vel *g*, *om* *MSUVjquvη*; superiori] inferiori *nv*, *om* *UV*

per .10. primi Euclidis *mg* *c*

3 in limbo] limbi *LTcimryz*; si] autem *add* *NSUV*; non] vero *MQu*; due *om* *Jt*, linee *add* *O*; recte] ad duo puncta predicta *add* *α*

4 alie *om* *Kzβ*; due] linee *X*, duas lineas *δ*, *om* *FJKdfβ*, linee (recte *R*) *add* *RW*; et...due *om* *Gp*; occupantes] alias designantes *λ*, continentes *μ*, et *add* *a*

5 Et] in *v*; 12] duas *ISUe*, 22 *v*

de divisione laterum *mg* *h*

6 in...protrahantur *om* *L*; linee] inter *add* *Gp*, usque *add* *X*; divisiones] partes *α*; designantes] signantes *K*, distinguentes *LTceiαλ*, significantes *z*, notantes *μ*; Et] in *n*, linea *add* *p*; inter] illas *add* *L*, aliquas *α*

7 ex *om* *z*; parte *om* *mr*; intercepta *om* *v*, que *add* *q*; dicuntur] dicimus *M*; et] quadrantis dextra et scilicet, et sinistra *add* *a*

8 superius] inferius *n*; punctorum] istorum *n*, ipsorum *add* *QZauη*; a *om* *t*

et dividendo iuxta artem lineam mediam quadrantis. Deinde in puncto A ponatur clavus subtilis cui alligemus filum de serico subtili, in cuius fili extremitate ponatur perpendiculum de plumbo vel alterius rei ponderose. Et margarita perforata moveatur super filum de loco ad locum. Et erit completa compositio quadrantis.

---

1 et dividendo om U; artem7 dictam λ, om ζ, datam add n; lineam mediam7 de linea media n; quadrantis7 scilicet in conum scale add ζ; et... quadrantis7 et non a cono scale altimetre Rpv ικ, om ABHILMNOPQTWXZ bcehijmoruwxyz αδεην, et non a cono scale altimetre add Kθ; Deinde7 Demum vw

Ultimo? de appositione perpendiculi sive (?) quod idem mg h

2 A om Jfkβδ; ponatur7 unus add UVg; clavus7 circinus X; subtilis om M; cui7 et θ; alligemus7 adjungemus Pp, alligetur cdeimrzμ; subtili om QZquη

3 fili om εμ; in cuius fili om ν; ponatur7 ponamus NSUVfkl, om MR; de7 in δ; vel7 aut θ, sine .λ, de add Fη

4 alterius rei7 altera re F, aliud α, de alia re μ; ponderose7 ponderosum α, om y, materie add η; super om SUVdg, unum add F; filum om SUVdgq

5 de..locum om z; compositio om v; quadrantis7 veteris divisa add q, ut prius infigura eius add y; Et...quadrantis om P; et dividendo... quadrantis om a; in duabus descendit (paragraph 27, l. 5)... quadrantis om (old foliation show one folio missing) E

Deo gratia add J; Explicit prima pars principalis (om U) huius tractatus scilicet (que est U) de compositione instrumenti (quadrantis U) add Ua; Sequitur nunc quadrans add κ; Ut patet in sequentia figura doluno? quae dicitur add μ

Sequitur de operatione quadrantis et primo de altitudine Solis invenienda

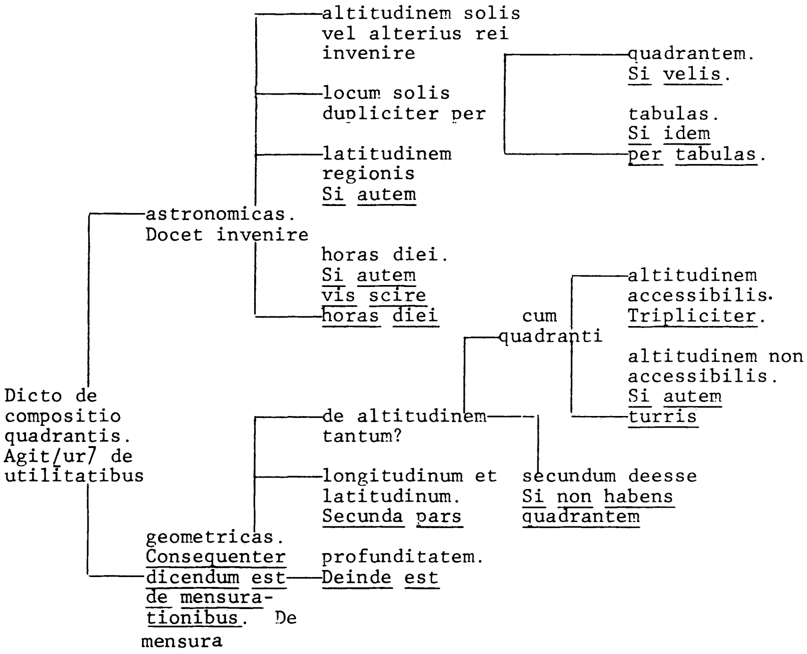
32. Dicto de compositione quadrantis, dicendum est de utilitatibus et operationibus, que habentur per eum.

---

1 Incipit pars illa que est de utilitatibus seu operationibus quadrantis primo de altitudine solis *A*, Sequitur de usu quadrantis et primo de altitudine Solis *BQjuη*, Sequitur de utilitatibus quadrantis (tam *ι*) in geometricis et astronomicis. Et primo de altitudine solis *CHYικ*, (Primum capitulum *Lbceil*) De utilitatibus et operationibus quadrantis *DLbceilmrvΥζ*, Sequitur de utilitatibus quadrantis in astronomicis, primo de altitudine solis (et cetera *G*) *GW*, De usu quadrantis et primo de altitudine Solis *Kqβ*, Sequitur de usu quadrantis de operationibus astronomicis et primo de altitudine Solis *M*, Secunda. De operationibus quadrantis *N*, Sequitur de utilitatibus quadrantis in geometricis et astronomicis per 4 tabulas eius et e contrario *R*, Solimetria *S*, Incipit practica eiusdem *U*, Incipiunt operationes quadrantis et primo de altitudine Solis *Z*, Incipit secunda que est de usu ipsius habens 2 principales. Prima est de usu eius in astronomicis *a*, Sequitur de utilitate (utilitatibus *t*) quadrantis *ht*, Pars secunda: De utilitatibus et operationibus quadrantis. De altitudine Solis invenienda *s*, Sequitur de utilitatibus quadrantis astronomicis et geometricis, et primo de altitudine Solis *x*, Sequitur de operationibus quadrantis et primo de altitudine Solis *δ*, De altitudine Solis invenienda in hora omni per quadrantem *ε*, Sequitur de usu illius quadrantis. Capitulum primum *θ*, De utilitatibus et operibus que habentur per quadrantem et primo de altitudine Solis *λ*, *tit om rell*

De utilitatibus quadrantis *add in text κ*; *titles repeated passim mg η*

2 Chart r:


Dicto de compositio quadrantis. Agit/ur7 de utilitatibus
astronomicas. Docet invenire
altitudinem solis vel alterius rei invenire
locum solis duplicter per
quadrantem. Si velis.
tabulas. Si idem per tabulas.
latitudinem regionis Si autem
horas diei. Si autem vis scire horas diei
geometricas. Consequenter dicendum est de mensurationibus. De mensura
de altitudinem tantum?
cum quadranti
altitudinem accessibilis. Tripliciter.
altitudinem non accessibilis. Si autem turris
secundum deesse Si non habens quadrantem
longitudinum et latitudinum. Secunda pars
profunditatem. Deinde est

3 Dicto] Scito δ; compositione] preparatione μ; quadrantis] deinde add X, nunc add α; dicendum] hic μ; dicendum est om B; de²] in w, qualitatibus et add f

Hec agitur de secunda parte scilicet de utilitatibus et operationibus quadrantis et primo de operationibus penes motum sol ut loco eius utroque et latitudine regionis et de horis in illa. Secundo de operationibus mensurationem ibi Consequenter mg Dl; (Dicto de compositione D) Sequitur de utilitatibus eius et primo quantum ad utilitates astronomicas. Secundo quantum ad geometricas. Quantum ad hoc primo quomodo tenendo quadrantem per ipsum altitudinem solis vel alterius habeamus. Secundo in quo gradu sit sol dupliciter. Si velis. Tertio ad habendum declinationem solis dupliciter. Si velis. Quarto ad habendum latitudinem regionis tripliciter. Si autem. Quinto ad habendum horas diei dupliciter ibi Si autem mg Dl; (Dicto de compositione K) Secunda pars principalis de utilitate quadrantis et primo contineat se ad priorem? distantiam?. Secundo prosequitur signi hoc primo de utilitatibus astronomicis, secundo geometricis. Consequenter dicendum. Ad hoc primo docet accipere altitudinem solis vel (altitudinem rei K) (alterius stelle fixe h), secundo de loco solis inveniendo dicitur. Si velis. Tertio de declinatione solis habenda dicitur. Si velis. Quarto de latitudine regionis dicitur. Si autem latum (om h). Quinto de horis habendis dicitur. Si velis scire (om h) (post paragraph 27 K) mg Kh; Dicto de usu quadrantis et primo de utilitatibus pertinentibus ad astronomiam. Secundo ad geometriam. Consequenter dicendum hic habet 5 partes. Primo docet accipere altitudinem. Secundo de inveniendo gradu Solis dicitur. Si vis. Tertio de declinatione Solis habenda dicitur. Si velis. Quarto de latitudine regionis habenda tripliciter. Si autem latitudinem. Quinto de inveniendis horis dicitur. Si vis scire (post paragraph 38) mg b; Dicto de compositione. Secunda pars prius de utilitatibus quadrantis et primo de utilitatibus astronomicis secundo geometricis illi Consequenter. Primo in 5 partes primo docet altitudinem Solis vel alterius rei capere per quadrantem et modus eum tenendi. Secundo docet invenire locum Solis et hoc dupliciter. Si velis. Tertio docet invenire declinationem et hoc dupliciter. Si velis. Quarto docet regionis latitudinem invenire. Si autem. Quinto docet horas diei invenire dupliciter. Si autem in speciali secunda pars prius de utilitatibus quadrantis et primo de astronomicis. Secundo de geometricis mg c; Caput primum de operationibus quadrantis mg T; chart of material similar to above, in outline form, p. 44, mg r

4 utilitatibus] vero add n; operationibus] operibus λ, quadrantis add ABGHORWXYZhmoprxε; habentur] erunt x; per] in i; eum] ipsum OXα; que...eum] ipsius l, per ipsum exercentur wδ

33. Si igitur velis scire altitudinem Solis in omni hora per quadrantem, pone punctum A quadrantis versus Solem et punctum C versus te, et dimitte radium Solis transire per ambo foramina duarum tabularum perforatarum. Et vide quem gradum ex gradibus in limbo abscindat perpendiculum, et respice numerum graduum sumptum superius, et numerus graduum ostendet tibi altitudinem Solis.

---

1 in om mr ζ; omni7 terra add δ; per om d

hec altitudo debet intellegi secundum azimuth id est secundum circulum in celo ymaginationem transeunte per zenith capitis eius et per centrum solis quando altitudo solis est arcus huius circuli a centro solis usque ad orizontem descendentem mg a; Secundo de altitudini Solis vel alterius stelle mg h

2 punctum^{1}7 scilicet add c; quadrantis om vxz; punctum^{2} om Qq; C7 T p

3 te7 terram, N, cenith n; dimitte7 permitte α; transire7 pertransire RY, intrare n λ; per om ν; ambo7 duo Nfo

4 duarum om I; vide7 signa super W; Et...gradum7 Quod gradus d; ex7 in UV; ex gradibus7 pertingit μ, om IPv; in7 ex X

5 in limbo7 limbi ILOUVcemryz γ ζ; abscindat7 tangat I; respice7 accipe mr; sumptum7 ostensum I, scriptum MQTZabceqrtux ζ η λ, om d

6 superius7 P a parte puncti B add k; et...graduum7 qui ILTceimrsz γ ζ; tibi om Gp; Solis om d

Solis7 scilicet quolibet die super orizontem numerum add s

Capitulum. Ad sciendum in quo gradu signi sit Sol per cursorem

34. Si velis scire in quoto gradu signi sit Sol per cursorem, respice in quo mense es et in quoto die illius mensis, et pone filum perpendiculum super illum diem in cursore, et nota super quod signum sub illo mense et super quem gradum illius signi cadit filum, quia in illo signo et in illo gradu illius signi erit Sol.

---

1 Regula ad inveniendum in quoto gradu signi sit sol ex die mensis per cursorem (et e converso ι) CGHRWYι, De gradu solis per diem mensis (datum per cursorem K) inveniendo (et e contrario Mjou) KMQjoquη, Secundus. De gradu Solis inveniendo per cursorem a, Ut scias in quo gradu est Sol. Capitulum secundum mrζ, In quo gradu signi sit Sol (per cursorem ostenditur et cetera x) tx, Sequitur de gradu solis (et die mensis inveniendo et primo per quadrantem ε) εβ; Capitulum7 Secundum N, Secundum capitulum Lei, Tertium capitulum c, Sequitur κ, Caput 3 T; sciendum7 investigandum DEγ, habendum h, inveniendum βκ; quo7 quoto κ; signi om Tbl; sit om Le; Sol om δ; per cursorem7 omni die Z, om LTbceil; tit om rell

Secundum (tertium D) capitulum in quo docet invenire (in quo gradu sit Sol Dl) (locum Solis c) et primo per quadrantem secundo per (quasdam c) tabulas (Si velis scire c) Dcl

2 quoto7 quo FIQTacefknqtvxyαβγδθν; gradu om f; signi om df; Sol7 ex die mensis add Gp

3 quo7 quoto Ndo, in add R; mense om p, tu add αθ; es om RTceosz; quoto7 quo Tμ; illius om t; mensis7 es add Xo; et pone7 appone f; filum om adoν, seu add QZjluη, vel add q

4 perpendiculum7 cum perpendiculo CHRYhmrvxζθικλ, perpendiculi NSVbcδμ; nota om d; quod om z

5 sub7 in SVgh; quod...super om ι; quem om Jf; illius signi7 signis p; cadit7 cadat a

6 signo7 gradu qη; in^2 om uδ; illo^{2}7 eodem δ, om h; gradu7 signo η, om d; illius...gradu om S; sub...gradu om U; illius om MZdεκ; signi om MZεη; et...signi om μ; signo...signi7 et illo signo Q; quia...signi7 quod in illo gradu et illo signo ju; cadit...signi om Vgwzα; Sol om Jf; Si velis...Sol om B

De eodem per tabulas

35. Si velis scire in quo gradu signi sit Sol per tabulas factas ad quadrantem, vide in quoto die mensis es et in quoto mense anni.

---

1 Ad sciendum in quo gradu (signi cuiuslibet A) sit (om c) Sol per (om T) tabulas (om T) (quadrantis ad hoc factas A) ADEILTbceklγ, (Tertius a) De gradu Solis inveniendo (per [4 κ] tabulas aεκ) (quadrantis ε) Baεκ; De gradu Solis inveniendo ex die mensis dato per 4 tabulas (eius e contrario [converso Wι] GHRWYι) CGHRWYι, De gradu Solis per diem mensis datum in tabulis inveniendo K, In quo gradu signi sit Sol per tabulas ex die mensis dato x, Ad inveniendum idem per 4 tabulas quadrantis β, Sequitur de gradu Solis per diem mensis in tabula θ; De eodem] Item aliter h, Idem t; tabulas] quadrantes add MQjqu, Secundarum add N, Capitulum tertium add mrζ; tit om rell

Regula ad inveniendum in quo gradu sit Sol per tabulas mg Dl; Idem aliter per tabulas mg b; Hoc secundo docet invenire locum Solis per tabulas mg c; Quarto de gradu Solis per tabulas mg h; Quia umbra unius visae rei est equalis sue altitudini mg q

2 Si] autem add λ; scire] idem id est add γ; gradu] cuius add γ; signi om DEFKbdflpκ; in quo...Sol] (hoc α) idem ITceimryzαζ; per] quasdam add μ; tabulas] quasdam (4 ITceimryzζ) add DEFIJKMNTUVabcdefiklmnrstwyzβγδζλ, quadrantis add MZkqu

3 factas om αβ; ad] per Xμ, a j, in n, om β; quadrantem] quadrante j, quadrantis β, quantitatem JLceikstyz, 4 annorum add ILTceimrsyzγζ; vide] unde ν; quoto^1] quo ISXgδθ; die om Xg; die mensis] mense anni nδ; es om LMjn; in^2 om Bz; quoto^2] quo Nαθ; die...quoto^2 om e

4 anni] tu es θ, est sciendie add y; mense anni] die mensis (es n) gnδ; die...anni] mense et in quota die mensis es b; es...anni om μ

36. Et scire debes quod quatuor sunt tabule: prima est ad annum bisextilem, secunda est ad annum primum post bisextum, tertia ad annum secundum post bisextum, quarta ad annum (58v) tertium post bisextum.

37. Quere igitur tabulam respondentem anno in quo es, volo dicere, si tu es in anno bisextili, intres ad tabulam ad annum bisextilem, et sic deinceps: et intrabis in primam lineam tabule cum numero diei mensis in quo es, ut si in quarto die es, intra

---

1 quod7 quia n; tabula7 ad hoc add α; prima7 una S; est om MQZjqu

2 bisextilem om BMOVadlstvxη; est om FJLMQTUZadgjmoqrtuvζθ; ad^{1}7 prius add o; annum^{1} om P; primum7 secundum UV, om Sμ, annum add Q; est om ν; post7 om γδ, annum add θ; tertia7 (vero λ) est add DEIXavαγεζθιλ

3 ad...secundum om δ; post^{1} om γ; bisextum^{1}7 sequentem U, om γ; tertia...bisextum^{1} om n; quarta7 (vero λ) est add DEIabflptvαθλ; annum om α; tertium7quartam C; tertium...bisextum^{2} om U; quarta... bisextum^{2} om Rδ

4 Quere7 quia n; igitur om θ; quo7 tu add KTceflmnrγζ

Et ad hoc habendum ostendet tunc divide annos per 4 et si nihil remanente: es in anno bisextili. Si unitas: es in primo anno post bisextili. Si 2 in secundo. Si 3 in tertio post bisextili et sic deinceps mg K

5 volo dicere7 verbi gratia CGRpθι, volo igitur H, ut imγζ, unde z, om L, quod add V; tu om Nmvzγζ; volo tu7 ut si ITcer; es7 respice add θ; si...es om λ; bisextili7 tunc add λ; intres7 tres p; ad^{1}7 in MOQabuσ, primam s, om Ziqμ; tabulam7 scilicet add s; respondentem ... tabulam om APWYgoxαεκν; ad^{2}7 in CKβ

6 bisextilem7 ordinatum add I, in tabulam add b, si (tu 5) es in primo (anno s) post bisextum intres secundum tabulam add (post primam v) sv; ad...bisextilem7 tabulam primam v; respondentem...deinceps7 ad annum in quo es h; in7 per θ, om Xarvζ; tabule om θ

7 numero om oν; quo7 tu add nyγλ; es^{1}7 est o, om eqw; ut7 et h, unde z, om Y, si in primo die mensis es intra cum primo add γ; si om δ; quarto7 quo W; die7 mensis add CEFIKLTaceimryz βγζθμ; es^{2} om ITbfδ; intra7 intrabis SUVkstyδθ, om g

cum 4, si in quinto, cum 5 et sic de aliis.

38. Et in superiore capite tabule inquire mensem in quo es, et descendo sub illo mense directe in oppositum numeri dierum cum quo intrasti, et numerus in angulo communi respiciente numerum cum quo intrasti primo et mensem in quo es, ostendet tibi signum et numerum graduum in quo Sol est.

---

1 in7 intra v; quarto die...om α; quinto7 2 β, die es (intra X) (iuxta o) add AGHMRWXYaopεκ, intra (5 c) add CDEILNPTcαγ, intres add i, intrabis add θ, es add μ; cum2/ in θ κ; 57 2 β; quinto... 57 secundo intra cum 2 K; si...5 om h; aliis7 ceteris y; de aliis/ deinceps ν; sic...aliis7 cetera ILTcimzζ; quinto...aliis7 qua intra cum 5 e

2 Et in7 cum T; superiore7 inferiore ε; capite7 parte ov, vel parte add N, scilicet ubi menses sunt inscripti supralin s; inquire7 querе B; quo7 tu add nyγλ; in quo es om B; volo dicere...es om d

3 et descende7 descendo OWXagα; sub7 in ν; illo om X; mense7 est add q; descende...mense om V; directe om α; oppositum7 eius descende add UV, ei add n; sub...oppositum7 in illo in oppositum directe s; dierum7 mensis add SV; cum om R

4 quo1/7 tu add n; intrasti7 primo add UVf; cum...intrasti om d; et7 in λ; numerus om α; communi7 totu κ, om CSktβθ; respiciente7 respice α; communi respiciente7 correspicientem (stet) n; numerum7 dierum add MNQbjoqδν; in...numerum om J; cum7 in W

5 et...intrasti om pv; et1/7 sub nλ, in add α; mensem7 mense nαλ; signum7 gradum DSUVbdfltλ, residuum J, de (om δ) gradum signi wδ, om OXagα; et2/7 in v, per κ, om OXagα; numerus...et2 om f

6 graduum7 eius add ILTceimrzγζ, signi add α; Sol om ζ; est7 blank half-line) a sole istius signi in quo Sol est add α; Si velis (paragraph 35)...est om η

illo...est7 mense usque in directum numeri dierum mensis quem invenies in sinistro latere tabule invenies in angulo communi verum locum Solis si fuerit annus primus post bisextum. Si fuerit annus secundus post bisextum subtrahe ab invento 14 minuta. Si fuerit tertius post bisextum subtrahe 28 minuta. Si fuerit annus bisextilis et locus bisexti non transiverit subtrahe 42 minuta. Secundum si locus bisexti transiverit adde super inventum 14 minuta et habebis verum locum solis ad illum diem B; (?) altitudine, (?) gradus solis dicitur, (?) declinatione dicitur, (?) latitudine dicitur, (?) horas dicitur (list with left margin trimmed) mg b

Ad habendum declinationem Solis per quadrantem

39. Si velis scire declinationem Solis et que sit distantia eius ab equinoctiali per cursorem, pone filum super principium Arietis et Libre, et nota gradum in limbo super quem cadit perpendiculum. Deinde pone filum super gradum in quo est Sol secundum artem iam dictam et nota gradum in limbo super quem cadit

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1 (Quartus: a) De declinatione Solis habenda (invenienda BKaβε, om MQhjqu) per quadrantem (quadrantis Q, cursorem Aahqβ) (cum cursore M) ABCDGKMQRWYahjqtuβεηικ, Tertium capitulum. De declinatione Solis et eius distantia ab equinoctiali Lcei, Caput 5. De declinatione Solis et cetera ab equinoctiali T, Tertium capitulum. Ad inveniendum declinationem Solis (primo c) per quadrantem; secundo per tabulas et si velis (mg c) cl; habendum7 sciendum mrζ, inveniendum x; quadrantem7 cursorem in quadrante x, Secundum add N, Capitulum quartum add mrζ; tit om rell

2 scire om z; Solis7 per quadrantem add jn, in quadrante add λ; et7 id est λ; et...sit7 id est h

3 eius7 Solis λ; equinoctiali7 anguli μ, circulo add nλ

4 et libre om Wq; gradum om GWp

superpone super lineam mediam cursore mg θ

5 in...perpendiculum7 ubi (in quo α) cadat filum in limbo GWXagpα; et ...perpendiculum om ε; pone7 iterum add ACGHIRYZhjpvxηθικ; (super e) principium...super om BDEFJKLMNPQSTUVbcdeiklmnorstuwyzβγδζλμν in om J

scilicet principium Arietis et Libre mg ζ

6 iam7 quam y; principium...dictam7 super lineam mediam cursoris f; cadit...quem om q; quem7 gradum add ν; cadit7 ostendet n

cadit7 filum. Et postea pone (om β) filum super lineam mediam cursoris. Et nota super quem gradum limbi (in limbo BDEFINUVbcdiklnoquwβδν) cadat add BDEFIJKLMNQSTUVbcdijklmnoqrstuwyzβδζμν

Alia littera: Pone filum super super principium Arietis et Libre. Et nota gradum in limbo super quem cadit perpendiculum. Deinde pone iterum filum super gradum in quo est Sol secundum artem iam dictam et nota super quem gradum et cetera mg K; cadit7 id est super principium Arietis et Libre superalin l perpendiculum et computa quot sint gradus in limbo inter primum gradum et ultimum, et tanta erit declinatio Solis.

De eodem per tabulas

40. Et si velis scire idem per tabulam, cum gradu Solis iam invento intra in prima linea tabule declinationis, et quere signum

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1 in limbo...perpendiculum] ubi cadet filum in limbo Oa; et] Deinde η; computa] nota SUV, om z; sint om z; quot...gradus] tot I; super... limbo om e; primum om f

2 gradum om Bowδν; gradum et ultimum] notam et secundum EIKLOceimryz βγζ, supralin θ; Solis om O, ab equinoctiali add α, Si velis... Solis repeated, with these additions and substitutions: cadit (para. 39, l. 6)] filum. Et postea appone filum super lineam mediam cursoris. Et tunc nota super quem gradum in limbo cadat perpendiculum. Deinde computa...Solis η

3 De eodem inveniendo per tabulam cum graduum Solis A, De declinatione Solis habenda (om KMQZhjqtu θ) per tabulas (invenienda K) (Rubrica ι) BCGKMQWYZhjqtu θικ, Inventio declinationis (solis x) per tabulas Dclx, Ad habendum declinationem Solis (habendum H) per tabulas EHIei αγ; De altitudine Solis habenda per tabulas. Rubric R, Habendum declinationem Solis et cetera T, De inventione eiusdem per tabulas declinationis β, De declinatione Solis invenienda per tabulas ε; De eodem] Idem aliter b; tabulas] (Capitulum mζ) quintum add amr ζ; tit om rell

Tertium capitulum ad inveniendum declinationem Solis per quadrantem secundo per tabulas. Et si velis mg D; primo de declinatione Solis per tabulas mg h

4 scire om AGHOPRWdhopvxεικν; idem om V; tabulam] tunc add MQZqu; cum] in n; gradu] scilicet in signo supralin J

Volve cartam et ibi in latere immediate subsequenter est tabula pertinens huic littere docens declinationem Solis secundum considerationem Ptholomei mg s

5 intra] ita p; in] cum D, om afmprζν; prima linea] primam lineam a; tabule] ultime α; declinationis om JSUVfkt, Solis add BFLTceimryz γζμ, Solis que dicuntur linee numeri add s; in...et] primo tabulas et per lineas tabuli nλ; quere] in quo add d, lineam add z

in quo est Sol in superiori captite tabule, et accipe e directo numerum signi cum quo intrasti declinationem Solis et habebis declinationem Solis certissime ad diem in quo accepisti gradum Solis.

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1 Sol om a; capite7 parte CUθ; et om λ; accipe7 habebis UV, om Bλ; e7 ex FGKSUVXgnpsαλμ, in Biv, om w

2 numerum om X, graduum add BMQZgjqu; signi om t; intrasti7 signasti γ, in add A, invenias add B; declinationem Solis om J

3 declinationem7 eam v, eius id est add s; Solis7 eius I, om Eev; et... Solis om Bdhzδ; certissime7 rectissime Yι, om μ; ad7 a F, in p, om J; diem7 die F, om J, anni add SU; in7 cum Js, om d; quo om d

4 Solis7 et sic de aliis add θ, oseruse nanensa add μ; Et si...solis om η

Ad inveniendum latitudinem regionis

41. Si autem vis scire latitudinem regionis id est distantiam cenith ab equinoctiali sive altitudinem poli, quod idem est, altitudinem Solis accipies in meridie Sole existente in principio

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1 De latitudine regionis habenda sive de altitudine poli A, De latitudine regionis invenienda (om h) BKhη ; De latitudine regionis habenda per altitudinem (latitudinem H) Solis meridiei (meridianam CHRWYι) (Solis. Rubrica ι) CGHMORWYcι, (Quartum capitulum Lei) (Caput 7 T) Ad (om ei) sciendum (om ie) latitudinem cuiuslibet regionis LTei, Secundum. Ad habendum latitudinem regionum N, De latitudine regionis invenienda per gradum Solis QZju, Sextus. De latitudine regionis a, De latitudine regionis invenienda (et ε) per gradus (gradum Solis ε) q ε, Latitudo regionis per quadrantem t, Ad inveniendum latitudinem regionis sive altitudinem poli per Solem, vel per stellas x, De altitudine cuiuslibet regionis hoc est ad inveniendum latitudinem regionis vel altitudinem poli β, Ad habendum latitudinem regionis per quadrantem δ, Sequitur de latitudine regionis invenienda θ, De altitudine regionis habenda per altitudinem Solis κ; inveniendum7 sciendum DEblmrsγζ, latitudinem7 cuiuslibet add DEblγ, alicuius add k; regionis7 6ᵐ add mrζ; tit om rell

Quartum (Quintum D) capitulum. Ad inveniendum latitudinem regionis et (hoc D) tribus modis: primo modo in Ariete et Libra Solis altitudo meridiana accepta tollatur de 90 et relinquitur (reliqua D) latitudo. (Secundo modo altitudini Solis meridiane declinatio Solis septemtrionalis subtracta vel meridionalis addita altitudinem equinoctialis ostendit, que a 90 subtracta latitudinem regionis ostendet Dc) mg Dcl; Primo de latitudine regionis et primo per altitudinem Solis in principio Arietis et Libris mg h

2 autem om Jhnθ ; regionis om a, ab add Gp, cuiuslibet add μ; id est7 et Tc

3 cenith7 regio d, om θμ ; sive7 sui E; altitudinem7 latitudinem K; poli om ε ; est om U

id est elevationem poli super orizonta mg h

4 altitudinem7 autem add F; Solis om T, quod idem est add W; accipies7 accipe Vaceμ ; Sole7 ipso ILTceimryzγζ; existente7 exeunte ε; in principio om X

Arietis vel Libre. Et illam altitudinem subtrahe de 90 gradibus, et residuum erit latitudo regionis sive altitudo poli.

De eodem secundum aliter

42. Vel sic: Accipe altitudinem Solis in meridie, et de altitudine Solis subtrahatur Solis declinatio eiusdem diei, si Sol est in signis septemtrionalibus, vel addatur si Sol sit in

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1 vel7 et Vcght; de7 a JSUktw; 907 30 p

2 erit om C; latitudo7 longitudo I, altitudo bvwα; sive7 aut θ; latitudo...sive om Z; poli7 quod idem est add F; sive...poli om h

3 Aliter de eodem G, (Secundum, N) De eodem sed aliter Nsδ, Septimus. De eodem per alium modum a, Secundo modo b, Item aliter h, Idem igitur sed aliter t, tit om rell

4 Vel sic om α; Solis om Ol, et add α, de altitudine Solis7 ab illa μ; in om T; de7 ab Faz, om p, latitudine de nocte et add O

meridie7 cuiuscumque diei MQjquη, cuiuslibet θ, cuiusque die mg K; Secundo de altitudine poli per altitudinem Solis quolibet die et declinationem mg h

5 altitudine7 ipsa ITceimryzζ, quibus B, illa Fa, latitudine ε; Solis^{1} om BFITceimryzζ, in meridie add Gp; de...Solis^{1}7 ab illa a; in...Solis^{1} om d; subtrahatur7 subtrahe ITcemryz; Solis^{2}7 eius ILTcemryz, om f; declinatio7 declinationem Icey; eiusdem om uv; diei om uvw, et add f; eiusdem diei7 in eadem die (om z) ILTceiryz

6 si^{1}7 scilicet add s; Sol^{1}7 ipse ILTceimryzζ; est om δ; in^{1} om B; signis7 in add W; vel7 ei add S; addatur7 adde ceimr; Sol^{2} om BJTUV ceghimrtζ; est...Sol^{2} om L; sit7 est B; in^{2} om n

et de...septemtrionalibus7 hoc ostendet fieri cum una tabula iacente in Sole existente in meridiem et etiam unus circulus debet fieri in tabula cum uno stilo fixo in centro sic videlicet α signis meridionalibus, et quod post subtractionem vel additionem remanserit subtrahatur a 90 gradibus, et habes latitudinem regionis sive altitudinem poli.

De latitudine regionis habenda per aliquam stellam fixam

43. Vel sic: Accipe altitudinem alicuius stelle fixe notabilis iuxta polum quando est in maiori altitudine de nocte, et altitudinem

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1 signis om α; septemtrionalibus...signis om Id; vel...meridionalibus om pzμ; meridionalibus/ australibus u; quod/ quicquid w, om a; post om Qε; vel additionem om UVα

2 remanserit] provenerit Bh, om X; subtrahatur] subtrahe ITUceimryzλ; a] de ILTceimnrzζλ; gradibus] ut prius ILTceimrz, gratia l, om gh, ut prius add Iyζ; habes] residuum est MQUVZjquη, scilicet ex residuo add GKp; latitudinem] latitudo MQVZjη, altitudinem aα, om μ

3 sive] vel ILTcemrζ; altitudinem] altitudo MQVZjuη; regionis...altitudinem om dy; poli om Ltε; latitudinem...poli] quod queris h

4 Aliter de eodem G, Secundum. De eodem sed aliter N, De altitudine poli per stellas Qq, 8^{m}. De eodem per alium modum a, Idem (Item h) aliter bh, De eodem per aliquam stellam k, Item de eodem sed aliter. Videlicet per aliquam stellam fixam s, Idem sed aliter t, De eodem sed aliter δ, tit om rell

Tertio modo per stellam non occidendum altitudinem maiorem et minorem horum differtia divisa addita minori altitudini vel maiori detracta latitudinem regionis ostendet (oportet c) mg Kcl; Idem tertio modo mg b; Tertio de altitudine poli per stellas mg h

5 Vel sic om α; Accipe om GWXp; altitudinem] latitudinem μ; fixe om nβθλ; notabilis] mobilis Bnλ

6 iuxta polum om c; quando] ipsa add MQZqu; est om p; quando est] cum fuerit ILTceimryzζ; in om n; maiori] sua add ILTcimryzζ; de] in mrγζ, om B; nocte om B, (vel z) (et QZjuη) (illa servetur MQZjquη) (Item ILTUcimryzζ) accipe (tibi UZ) add IJLMQSTUVZacfijkmnqrtuyz δζηλμ; et] etiam MVanqtλ; altitudinem] altitudo N

eiusdem stelle quando est in minori altitudine in eadem nocte vel alia; et minor altitudo subtrahatur de maiori et medietas differentie addatur altitudini minori, et quod inde provenit est altitudo poli sive latitude regionis.

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1 eius om q; stelle om JUae; quando] ipsa add MQZjq, ipsa est minima sive add η; quando est] cum fuerit ILTcimryzζ; in maiori...est om e; minori] maiori vzδ, sua add ILMQTZcdeijmqrzη; de...altitudine om g; in^2 om vδ; et...nocte] eadem w, om γ; vel] in add ILMQTZbcde iqsuαη

2 vel alia om hv; alia] quere add W, scilicet nocte supralin s; et^1] ut g, tunc add MQZjquαη; minor] de minori add z; altitudo om Ieimrζ; subtrahatur] extrahatur n; de] a θ, om Fz; maiori] altitudine add Iei, om z; differentie] minoris add γ

3 altitudini] alteri n, om q, in add β; minori om Iι; inde] in w, om Ja; quod inde] quoniam W; poli om a

minori] vel subtrahatur (subtrahe F) a (ab altitudine F) maiori add (post altitudini I) EFIKLTceimrsyzβγζ, id est residuum de maiori subtrahatur mg Y, maiori aut subtrahe ab altitudine minori μ; illegible note mg K

4 sive] seu s; latitudo] altitudo wyα, om ε; regionis om eλ; sive... regionis om h

regionis] et nota quod stella (stelle λ) nautica (nautice λ) describit (describunt λ) quemdam circulum circa polum (celum λ) quod in suo diametro continet gradus octo est que dictus polus semper (om λ) inter ipsam (stellam λ) et maiorem ursam add (post latitudo λ) nλ

Sequitur de dispositione cursoris

44. Si autem vis scire horas diei in omni regione, vide latitudinem regionis sive altitudinem poli, ut dictum est, que est in

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1 De hora diei in omni regione A, De inventione hore diei per quadrantem. Primo cum cursore B, De (Ad R) inventione (inventionem R) hore naturalis per quadrantem cum cursore CGHRWYZκ, Ad habendum horas diei cuiuslibet in omni regione DELbceilλ, De hora diei naturali per quadrantem cum cursore invenienda K, Inventio hore naturalis per quadrantem cum cursore MQjuεη, Secundum. Dispositio cursoris N, Nonus. De inventione horarum per cursorem a, De horas habendis et primo de situ cursoris h, (Captitulum m) 7^{m} De horis inveniendis mrζ, Inventio hore vel quadrantis sine cursore q, Sequitur de dispositione cursoris, Ad sciendum horas diei naturalis in omni regione s, Ad inveniendum horas diei naturales per quadrantem cum cursore x, Ad inveniendum horam diei naturalem per quadrantem in omni regione β, De horis diei inveniendis in omni regione. Sequitur capitulum Rubrica ι, De inventione hore naturalis λ; Sequitur om δ; tit om rell

5^{m} Hic 5^{o} docet invenire horas dierum sed primo docet situare cursorem dupliciter. Secundo de horis Cum igitur mg b; Quartum et ultimum capitulum. Ad inveniendum horas diei naturales dicitur per quadrantem cum cursore. Secundo sine cursore. Si autem. Ad hoc primo docet dupliciter cursoris situationem. Secundo hore inventionem Cum igitur mg cl; Quarto De horis et primo de situ cursoris mg h

2 autem om Nhnoαιλ; diei7 naturales (in omni die y) add ILTceimrsyzζ, cuiuslibet add μ; regione7 die ILcirzζ, die add e, primo add n; vide om ε

vel regione mg ζ

3 latitudinem7 altitudinem Hv, longitudinem J, diem ε; sive7 omni add D; altitudinem7 latitudinem δ; poli om aκ; sive...poli om q; ut om R; est^{1} om j; que om DHLNOPWXbghlouxε; est^{2} om DFHLNOPWXbghlouxε; ut...est^{2}7 sic dictum d, quod idem est quod dictum est α

Montepessulano 44 graduum fere et Parisius 48 graduum. Et computa tot gradus in limbo quadrantis, incipiendo a latere quadrantis super quod infixe sunt tabule perforate. Et ubi numerus ille terminabitur, move cursorem donec principium Arietis cadat sub ipso perpendiculo directe, et talis situs cursoris quadrantis erit in regione illa.

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1 Montepessulano] est add Qj, videlicet add α; graduum^{1}]gradus NQSZg, om h, 44 minutorum fere add V; 48] 49 Mqu, 44 X; graduum^{2}] om KSUdmnrzβζλ, fere add (post 48 Kmrz βζ) CEIKLaceimrsyzβζμ, 50 minutorum add V, fere et 49 minutorum add γθ; 48 graduum] 44 graduum non Z; computa] computantur T

fere] aliter terre mg N, et in Castro Plebis 42 et Padua 47 add λ; graduum^{2}] id est plus supralin L et Coventry 52 graduum add α

2 tot] quod W; quadrantis^{1} om HP; incipiendo] computando ι, om BILTcei mrz; a] in i, parte vel add L; latere] dextro add d; quadrantis^{2}] eius Fa, om B; incipiendo...quadrantis^{2} om κν

3 infixe] fixe Qqtμ; perforate om ζ, et ponatur filum add B, a latere dextro add N; quadrantis super...perforate] dextro (in quo fixe sunt y) (tabule perforate Iy) ILTceimryz; terminabitur] Deinde add B

4 Arietis] directe add B, scilicet equinoctialis linea add ILTceimryzζ; principium Arietis] linea equinoctialis γ; sub] super δι; ipso] illo (filo B) Bg, ipsum ι, om SUVα; perpendiculo] perpendiculum ι, om J

5 directe] recte λ, om J; cursoris om ACDEFGHILPRTYZabcdfghijlmoprxyzβγεθ; quadrantis om BMOQXquζ, eternus add JNSUVntwδλ, perpetuus add WXbhjqsuvηθ; cursoris...erit] incipiendo a latere cuius erit perpendiculus μ; illa om Ffkt; in...illa om U

De eodem secundum aliter

45. Vel sic: Accipe altitudinem Solis in meridie (59r), et non moveas perpendiculum a situ in quo cadet, et move cursorem donec dies in cuius meridie accepisti altitudinem cadat sub perpendiculo; et iste erit situs cursoris perpetuus in illa regione.

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1 Secundum. De eodem sed aliter *N*, Item aliter *h*, De eodem sed aliter *s*, Idem sed aliter *t*, De dispositione cursoris similiter. Rubrica *δ*, *tit om rell*

alter modus situandi cursorem per altitudinem Solis *mg Dcl*; Quinta. De horis de alia dispositione sive situ *mg h*

2 Vel sic *om α*; Accipe *om β*

3 situ7 suo *add ζ*; in7 a *Qq*; in quo7 cadat vel *add μ*; a...cadet *om I*; in...cursorem *om ζ*; a...cursorem *om Tceimrz*

4 dies7 meridies *y*; in *om Umrζ*; meridie *om f*; altitudinem7 latitudinem *X*, *om j*, Solis *add Bgθ*; sub7 super *Jnε*; perpendiculo7 perpendiculum *Jnε*, filo *B*

5 erit *om V*; cursoris *om Jμ*; regione7 perpetuus *add e*

regione7 Si velis scire altitudinem lune aut alicuius stelle fixe, fac ut videas eam per ambo foramina dictarum tabularum et illam horam abscindet perpendiculum ex gradibus limbi aliquem numerum graduum qui ostendunt altitudinem lune aut alterius stelle vel planete et ista regula docet poni primum illam que sic incipit *Si velis scire altitudinem Solis* et cetera *add J*

De inventione horarum cursore disposito

46. Cum igitur cursor fuerit sic dispositus, pone perpendiculum super diem cuius horam vis habere, et trahe margaritam donec cadat super lineam circumferentialem ultimam que est finis sexte hore; post hoc dimitte radium Solis transire per utrumque foramen, et nota locum margarite in horis, quoniam ipsa ostendit tibi horam diei in qua es.

---

1 (Secundum. N) Inventio horarum cursore dispositio Nbkstδ, Item aliter h, Inventio hore l, tit om rell

de horis inveniendis et primo per quadrantem cum cursore. Secundo sine cursore. Si autem mg b; Sexta de horis per cursorem mg h

2 Cum7 Si J; igitur7 iste add CEIKLTbimrzβγζθ, ille add y; sic om v; dispositus7 positus w; a 90 gradibus (paragraph 42)...perpendiculum repeated d

3 super7 illum add θ; cadat7 margarita add V

4 super7 sub f, illam add θ; lineam7 que circulus meridianus appellatur add mrζ; finis om fn; ultimam...finis om JSUVkt; hore7 et dicitur linea meridionalis supralin s

5 hoc om Gp; post hoc7 Et postea n; radium7 judicium κ; Solis7 intrare vel add nλ; transire7 intrare SUVkst, pertransire α, om θ; per7 super μ; utrumque7 ultimum μ; foramen7 duarum tabularum add SUV; nota7 bene add I

6 in7 quibus add θ; ipsa om a; tibi om θ; es7 presentis add α; in qua es7 naturalis ILMOPQSVWZceghikmrzζ, om Faftμ

Et dicit circumferentialem quia quelibet illarum 6 linearum est portio alicuius circuli mg s

Si enim cadat super lineam primam circumferentialem, erit prima hora; si supra secundum, secunda hora erit completa, et sic deinceps.

De inventione horarum per quadrantem sine cursore

47. Si autem idem vis habere per quadrantem sine cursore,

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1 lineam] horam mrζ; primam om eη; circumferentialem om n, prime add e; erit om t; prima] post d; hora om m, completa add CRYasvθικ, diei add f

2 secundum] erit add Oaμ, horam add θ; hora om Xgnwσ, scilicet completa supralin s; completa om gnwαδλ; erit completa] quam ostendit completam et cetera θ, om μ; hora...completa] si supra tertiam, tertia G, om ABDFHMNPQSUVWZabdjkloqtuxηγ; secunda completa] tertia si secunda tertiam, tertia p, om f; si...completa] in toto spatio usque ad secundum lineam et illi (ibi E) est initium secunde (hore yz) usque ad tertiam EIKLTceimryzβξΥ, super secundum secunda, om h; sic om q

Aliter: erit prima hora completa. Si supra secundum secunda hora erit completa. Et sic deinceps completa mg K; illegible note mg K

3 Inventio eiusdem hore (om Qqu) per quadrantem sine cursore (capitulum A) ABCGHQRWYkquεικ, Inventio hore in quadrante sine cursore per tabulam declinationis D, Ad habendum (sciendum Mjsθ) per (cum c) quadrantem (quadrante c) (sive e) sine cursore (et cetera L) ELMbcelsγθ, (10^{s} a) De eodem (eadem hore K) per (om amr) quadrantem (om amr) sine (om Z) cursore (om Z) (invenienda K) (Capitulum m) (8^{m} mr) KZamrx, (Secundum N) Idem per quadrantem sine cursore Nt, (Caput 8 T) Ad sciendum quadrantem sine cursore Ti, Item aliter h, [De] inventione eiusdem sine cursorem et primo de formatione margarite j, Ad habendum horas diei naturales per quadrantem sine cursore β, Idem habet per quadrantem sine cursore δ, Ad habendum horas equales. 8^{m} capitulum ζ, tit om rell

4 Si] Cum d; autem om ILJTcdeiz; idem] horas diei y, om Jgκ; habere] scire IQRjq, om OWXγ; Si...cursore om α

Inventio hore per (in l) quadrantem (quadrante l) sine cursore per tabulas declinationis mg cl; Secundo. De horis sine cursore mg h accipe in quatuor tabulis quadrantis gradum Solis, et cum gradu Solis in tabula declinationis accipe Solis declinationem, et eam subtrahe de latitudine regionis in qua es, si Sol fuerit in signis septemtrionalibus, vel adde, si fuerit Sol in signis meridionalibus; et quod post subtractionem vel additionem remanserit, tene, et tot gradus computa in limbo a latere quadrantis super quod infixe sunt

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1 accipe7 et hec per tertium capitulum *supralin a*; in7 ex *z*; tabulis *om V*; quadrantis *om NWαλ*; sine...quadrantis *om d*; gradum7 motum *z*, *om U*; Solis *om U*; et7 tunc *add Y*; cum7 eis *d*; gradu7 quo gradus *δ*

2 Solis^{1}7 intra *add Y*; gradu Solis^{1} quo (intrasti *I*) *ILr*; et... Solis7 cum quo *Tceimyγζ*, *om hp*; tabula7 tabulis *c*; et...tabula7 cum quo intrabis *z*; declinationis7 declinationem *c*, solis *add μ*; accipe7 et hec per quintum capitulum *supralin a*; Solis^{2}7 eius *ACGHILMOPQRTWXYZcehijmpqruzαειk*, ea *g*, *om oxζν*, declarationem quam *add f*; accipe Solis7 accipiemus *v*; declinationem7 declinationis *ce*, *om y*, Solis in die illa *add α*; accipe...declinationem *om y*; et *om δ*; eam *om DEKbdloxαβδτ*, per sextum capitulum *supralin a*; et eam7 quam declinationem (*om ILTfimryzζ*) *FIJLNSTUVfikmnrstwyzγζλμ*

3 de7 a *DFKabceilmorzβγμν*, ab *fty*, *om EILTwδ*; latitudine7 altitudine *EILTfnptvwyδ*; es7 et hoc *add MQqu*; si *om w*; Sol *om E*

4 adde7 declinationem altitudini poli *add v*; fuerit7 sit *z*; Sol *om CKLSTcgmrβζθ*; in *om anz*; signis *om CLTWcmnrwzδζ*, alteris vel *add F*, australibus *add μ*; Sol...signis7 in *IQiq*, *om e*; septemtrionalibus... signis *om Sfy*; vel...meridionalibus *om d*

5 quod7 fuerit *add OWXgp*; post *om I*; vel additionem *om UVqδ*; post... additionem *om LTcimrzζ*; remanserit7 residuum *GOWXgpα*, provenerit *h*; in quatuor...tene7 altitudinem Solis in meridie illius diei cuius horam volueris habere per tabulam ad hoc factam *B*; tot *om z*

6 in *om SUV*; limbo *om SUV*, incipiendo *add B*; quadrantis7 dextro *add EKsβγ*, in limbo *add t*; infixe7 fixe *SUVt*; super...infixe *om a*

brief illegible note mg K

tabule perforate; et pone perpendiculum ubi terminatur numerus, et move margaritam usque ad lineam meridionalem, et ille erit situs margarite ad talem diem; tunc permitte radium Solis transire per ambo foramina, et nota locum ubi cadit margarita, et habebis horam sicut prius.

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1 tabula7 sunt add μ; perforate om S; super...perforate7 sinistro B, dextro ILTceimrtzς; post...perforate7 remanserit e; et... perpendiculum om Leirtzς; ubi7 ibi y; terminatur7 est add α; numerus om θ, pone perpendiculum add Leimzς

2 usque om ILTceimrzζ; meridionalem7 id est 6^{e} hore supralin Y; laterum add μ; situs7 finis I

3 margarite7 usque add y; talem7 illum ITceimryzζ; diem om d, E add o; tunc7 et n; permitte7 dimitte SUVgyα, talem add θ; radium7 judicium κ, solarem vel add θ; transire7 intrare mnrζλμ, pertransire α, om w; ambo7 due F, utraque α

Si fuerint .3. quantitates proportionales continue sive non continue note cuius quarta queratur, multiplicetur secunda per $.3^{am}$. et productum dividatur per primum et exibit $.4^{a}$. res accessibilis mg K; Si autem vis horas equales pone perpendiculum super orizontem scilicet lineam ab disposita primo margarita ad diem datum. Deinde move perpendiculum cum margarita ad meridianum et gradus limbi pertransit per margaritam divisi in 15. Dant tres equales in medietate diei illius quos si duplaveris exibunt omnes hore equales diei illius artificialis (surrounded by va-cat) mg l

4 per...foramina7 ut prius g; locum7 gradum X; ubi7 in quo mrζ; horam7 locum X, naturalem i, om ε, naturalem add ILTcemryzζ; sicut7 ut ITU ceimryzαζθ

5 prius7 et cetera add θ; pes erit curvi quod figura dicitur add μ; Si autem...prius om U

prius7 Explicit prima pars principalis de usu quadrantis add a, (Ad habendum horas equales ((9^{m} mr)) mrζ) Si (autem z) vis habere horas equales, pone perpendiculum super orizontem scilicet lineam AB. Disposita primo margarita ad diem datum. Deinde move perpendiculum cum margarita ad meridianum et gradus ibi (limbi z) pertransiti cum (per z) margarita (margaritam z) divisi in 15 dant horas equales in medietate illius diei quod si duplicaveris exibunt omnes hore equales diei illius add mrζ

Sequitur de altitudine

48. Consequenter dicendum est de mensurationibus et primo de mensuratione rerum altitudinum.

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1 De utilitatibus geometricis et primo de altitudinibus (altitudine Kβ) (mensuranda K) (rei accessibilis per quadrantem β) AKβθικ, De altimetria et primo de altitudine rei accessibilis invenienda B; De utilitatibus geometricis et primo in altimetria C, (Sequitur D) De rerum mensurationibus et primo de rerum (om L) altitudinibus (Capitulum 4^{or} L) DLϒ, Sequitur secunda pars utilitatis quadrantis de rerum mensurationibus et primo de rerum altitudinibus E, De utilitatibus geometricis et primo in (de G) planimetria de (in G, om κ) altitudine (om κ) (Capitulum rubricum ι) GHRWYικ, (Sequitur Z) De altimetria et primo de altitudine accessibili MQZjqu, Sequitur de mensurationibus Nkt, De turri inaccessibili mensuranda per quadrantem O, De mensurationibus Sg, Caput (Septimam capitulum ce, Sequitur de rerum bl). De mensurationibus et primo de rerum altitudinibus Tbcel, Incipit secunda scilicet de usu eius in geometricis habens 3 principales. Prima est de altimetria. Secunda canon de altitudine existente in loco plano a, Sequitur de mensurationibus et primo de altitudine rei inaccessibilis h, Capitulum 9^m. De mensurationibus et primo de altitudine rerum i, Secunda pars. De mensurationibus et primo de altitudine invenienda mrζ. Sequitur de mensurationibus altitudinum. Ad sciendum altitudinem alicuius rei accessibilis s, De mensuratione altitudinum rerum accessibilium x, Sequitur (om λ) de mensurationibus altitudinum δλ, De altitudine et primo rei accessibilis invenienda ε, De altitudine accessibili η, tit om rell

Secunda pars utilitatis quadrantis in quo docentur altitudines latitudines et profunditates rerum et etiam capacitates vasorum vel columpnarum. Et secundum (ibi cl) hoc pars habet 3 partes; Primo docetur de mensuratione altitudinum. Secundo de longitudinibus (longi c) et latitudinibus (lati magnitudine c) secundum (ibi cl) (Secunda pars Dl). Tertio de mensuris ysoperimetrorum corporum secundum Dicendum est mg Dcl; De geometricis operationibus mg O; Secunda pars mg m; Sequitur de mensurationibus et primo de altitudine invenienda mg ζ

2 dicendum] dicetur μ; est om eμ; mensurationibus] rerum inferiorum add MQu

Consequenter. (Pars secunda principalis que est de utilitatibus seu. Operatione. Geometrie et primo continuando? dat rectum ordinem prosequitur secundo prosequitur. Si vis scire. Et in hac K) Primo de altitudinibus (altimetria K, altitudine 1). Secundo de planis (planimetria K). Secunda pars. (et si vero res non est 1). Tertio (om 1) de (om 1) profundis (steriometria K, om 1). Dictum (om 1) est (om 1). Ad hoc primo docet (de K) invenire (mensurationibus K) altitudinem cum (per K) quadrante quadrantem K). Secundo sine eo (quadrante K). Si autem (om K) non habeas. Ad hoc (primo K) de (in 1) altitudinibus (om K) accessibilibus (accessibus K). Secundo inaccessibilibus (de inaccessibus K). Si autem turris. (Ad hoc ponit triplicem modum. Primo ad 45 (44 1) gradus (om 1). Secundo ad quodlibet aliud tertio secundum solem. Dcl (Primo iterum per inspectionem. Secundo per Solem. Item hoc idem. Item primo perpendiculo cadente per 45 gradus secundo alibi et melius. Vel sic. Item primo facit quod dictio est. Secundo docet recti planum. Si non res. K) mg Dkc, add post gradum, paragraph 49, 1. 4 1; Consequenter de utilitatibus pertinentibus ad geometriam et primo de mensuratione altitudinem. Secundo superficierum. Secunda pars. Tertio de corporum. Deinde est: primo per quadrantem. Secundo sine. Si non habes. Primo de accessibilibus. Secundo inaccessibilibus. Si autem turris. Primo per speculum et hoc dupliciter. Secundo per solem. Ponatur. Primo per altitudinem 45 graduum tantum mg b

3 mensuratione] omnium add Cθ; et...mensuratione om e; rerum om λ; altitudinem om α; Consequenter...altitudinem om n

49. Si vis scire altitudinem alicuius rei accessibilis, respice altitudinem rei per ambo foramina uno oculo, et accede ad rem vel recede a re in tantum donec perpendiculum cadat super lineam mediam quadrantis id est super 45 gradum. Deinde accipe altitudinem oculi tui usque ad plantam pedum, et tantum accipias retro te quanta est altitudo oculi tui ad terram et nota locum. Deinde mensura quot sunt

---

1 Si7 igitur add QRYZjquvyαικ; scire7 invenire I; alicuius7 magne add CRYvθικ; rei om μ; accessibilis7 ascensa vel turris μ

De altimetria tit S; et hoc si cadat perpendiculum super latus umbre verse secundum recede si cadat super umbram rectam mg a; et in planitie constitute mg u

2 altitudinem7 summitatem B; rei om a, accessibilis add ι; per ambo foramina om M; uno om n; vel7 et bk

oculo7 a parte ut uterque visualis magnis fortificetur add θ

3 recede7 retrocede θ; ad...recede om w; a7 de Aq, om JLTceimrstzζη; re om JLTceimrstzζη; vel...re om SUV; in om Pdgy; tantum om Pdg; mediam7 rectam α

et si cadat ibi in prima aspectione te non debes accedere nec recedere mg a

4 quadrantis om α; id est7 et Tβ, scilicet v; super om v; Deinde7 Et SV

5 tui om efηθ; oculi tui7 ab oculo tuo wδ; usque om z; pedum7 pedis μ, om Gp; accipias recipias IK, capias w; te om y; retro te7 recte p

illegible note mg K

6 tui om In, usque add FSUVXaghxαιμ; usque...tui om o; ad7 contra y; plantum...ad om Nν; terram7 plantam pedis n; locum7 terram μ, scilicet retro supralin a; mensura7 nota Zθ; quot7 quere a, quod n, quo p; sunt om WX

pedes inter notam et fundamentum turris vel alterius rei mensurande, et habebis altitudinem eius.

Ad habendum altitudinem non existentem in plano

50. Si vero res non est in loco plano, respice aliquod punctum in re mensuranda, perpendiculo cadente super lineam AB que est in sinistro latere quadrantis, et nota punctum. Et tunc non accipias

---

1 inter7 in e; notam7 te U, suum locum notatum add μ, vel nota tuum locum supralin Y; fundamentum7 altitudinem h, summitatem θ; turris om SV; vel om SV, basim add ILTceimrsyzγζ; alterius7 altitudinis JSVst,illius I; turris...alterius om Uλ; mensurande/ eius altitudine oculi tui add θλ; vel...mensurande om d

illegible note mg K: inter locum notum retro mg a

2 habebis7 hoc erit d, om o; altitudinem7 altitudo d; eius7 turris n, om q

eius7 si sit scilicet (om d) in plano add d, supralin s

3 Secundum. De eodem quando altitudo non est in plano N, Secundus. De altitudine existente in loco non plano a, Item aliter si vis non sit in plano h, Quando altitudo non est in plano, tit om rell

mensuranda rerum mg K; quomodo fit si non sit in loco plano mg c

4 vero7 non T, om H; res7 mensuranda add I; in7 aliquo add FGpv; loco om FNh

5 in re7 illa β, illa add pγ, supralin G, inde re add μ; lineam om ζ; AB7 A CRθικ, om γ; que est om, om ILTceimrzζ

Nota quod latus quadrantis quoddam tibi est propinquum est latus umbre recte reliquum vero umbre verse. Umbra recta est super faciem terre. Versa est cuiuslibet rei orthogonaliter stantis ut umbra fistule seu stili in pariete mg q

6 punctum7 in turri add Kζ; non om Aθμ; accipias om U

punctum7 Deinde supra respice per ambo foramina altitudinem (aliter summitatem supralin) rei: clauso uno oculo. Et accede vel recede in tantum donec perpendiculum cadat super lineam mediam scilicet super 45 quadrantis add s altitudinem que est ab oculo tuo usque ad terram, sed illius altitudinis sit altitudo puncti notati a terra; tunc quantum est inter pedem tuum et rem mensurandam, tanta est altitudo a puncto notato superius computando; adde tunc illi altitudini altitudinem puncti notati a terra, et habebis quesitum.

---

1 altitudinem om Z; tuo om nα; que est om μ; que...usque7 oculi tui ILTceimryzζ; sed7 si Faktw, om Xa, loco add HLMQZqsuvηθ, supralin Kι; illius7 oculi add e

in latere iuxta pinacula et latus umbre recte et verum umbre verse mg l

2 altitudinis7 que add θ; sit7 sive R; altitudo om g; puncti7 per add T; a terra7 ad terram e; illius...terra om B; tunc et n; quantum7 partem μ

altitudinis7 que est ab oculo usque ad terram add O; illegible note K; scilicet mensurando per lineam perpendicularem ad pedem et ad radicem rei mg a; alter inter oculum et punctum notatum ex illa mensuranda mg a; Umbra recta est in latere quadrantis quod cadit perpendiculariter super latus quadrantis in quo sunt tabule perforate. Et umbra recta est illa quod? jacit? quelibet terre super planum. Umbra versa est quod jacit? quodlibet rei? equidistans orizontis super altitudinem orizontis perpendiculariter insistente. Verbi gratia si autem proveniat stilus et similiter stilum radiet Sol in quo umbra versa directe ascendat per turrim vel ostendet per turrim dicitur umbra versa mg mr; Hec est distantia a terra usque ad punctum notatum mg u

3 tuum om mrζθ; mensurandam om ITcimrzζ; est om θ

pedem7 vel inter oculum et punctum notatum rei? mensuranda mg a; vel et erit pro numero punctorum per quem fiet divisio mg b; Hec est usque ad punctum rei mensurande notatum mg u

4 tunc7 et T, ergo v; illi om Bμ; altitudini7 alteri n, om eμ

Hoc est usque ad summitatem per visam rei mensurande cadente perpendiculo super 45 gradus mg u

5 notati7 pernoti q; quesitum7 et cetera add x

De eodem secundum aliter

51. Vel sic: Respice summitatem altitudinis rei per ambo foramina sicut prius, et considera super quem locum quadrantis cadat perpendiculum, et si ceciderit super latus umbre recte scilicet in dextro latere sume numerum punctorum umbre recte, respiciendo super quotum

---

1 (Secundarum N) De eodem sed aliter Nsδ, Tertius: De eodem per alium modum a, Idem sed aliter b, Idem aliter h, Idem sed aliter et per umbram t, tit om rell

Secundo per proportionem punctorum mg Dcl; illegible note K; Vide folio 56 mg V; Secundo per altitudinem quantamlibet mg b

2 Respice7 accipe SV; summitatem7 altitudinem θ; altitudinis7 alicuius CPYv, alterius θ, om Faμ

3 sicut7 ut eiryzζ; et considera7 considerando Fa; quem locum7 quod latus MQZjquη; cadat7 cadit a

4 et si7 Si autem nλ, om CRκ; ceciderit7 steterit AGHMOPQWXYZhjpuεη, cadat I, fuerit α, om CRικ, vel descendit add p, vel ceciderit supralin G; latus7 caput Fμ; scilicet om F

perpendiculum7 et nota 6 scilicet multiplica secundum per 3^m et divide per primum et exibit tibi .4. primum est punctum vel puncta umbre recte secundum est .12. terium distantia inter te et turrim 4^m altitudo turris add L; id est extense a sinistris quadrantis pro arcu mg V; Utrum cadat super latus umbre recte umbre verse unde cum fuerit solis altitudo plus 45 gradus cadet perpendiculum super latus umbre recte. Si vero minor 45 gradus cadet super latus umbre verse mg q

5 latere7 quadrantis add g, supralin K; scilicet...latere om SUV; punctorum om MOPQWZhjouvαεηικν; recte7 Item Z, id est add η; scilicet ...recte om RX; recte...recte om e; respiciendo7 respice F, id est aspiciendo L, de add q; scilicet...respiciendo7 consider B; super7 aliter y; quotum7 totum y, quem δ

punctorum7 scilicet que inter a perpendiculo usque ad latus dextrum quadrantis mg a; brief illegible note u punctum cadat perpendiculum. Si autem cediderit super latus umbre verse, per numerum ipsorum punctorum umbre verse divide 144, et quod exierit post divisionem sume.

52. Deinde mensura distantiam inter te et turrim, et quod fuerit

---

1 punctum7 gradum α; perpendiculum om B; latus om c

perpendiculum7 et sicut se habet numerus punctorum, ad 12 sic se habet distantia ad totam turrem add nλ; Hic semper pars? (?) (?) quantum in tantum elongeris vel appropinques rei mensurande quantum oculus tuus videat summitatem rei mensurande per ambo foramina instrumenti perpendiculo cadente super 45 gradus hoc suprascripto operaris ut subicum mg u

2 verse^{1}7 tunc add B, operare (sicut n) add nλ; ipsorum om BSUgmrεζν; punctorum om η, 4 add q; umbre om p; umbre (para. 51, 1. 4)... punctorum om μ; per...verse^{2} om d; divide7 deinde μ, per add Rsvκ, alius in supralin s; 1447 44 o

1447 quia per hanc divisionem habebit numerum punctorum umbre recte add α; que est proportio punctorum utriusque stationis per se (ad 12 eadem est /om t7 utriusque stationis per se DFbc) ad turrim. Sed que est proportio totarum proportionalium eadem est et differentiarum earumdum. Ergo que est proportio differentia punctorum 2 stationum ad 12 eadem est differentie (duarum c) stationum ad (om l) turrim (om l) (quod est propositum c) mg (para. 65 Fc, para. 58 bl, para. 59 t) DFbclt; id est absente a cursore pro arcu mg V; punctorum7 que scilicet sunt a perpendiculo usque ad latus sinistrum quadrantis mg a; Qui numerus est quadrantes duodenarii mg s; Nota quod si ceciderit perpendiculum in latere umbre recte per numerum punctorum umbre recte non oportet dividere 144. Sed ex numero punctorum umbre recte debemus operari sicut operamur ex numero qui provenit ex divisione punctorum umbre verse in 144 mg s; quod exempli gratia sint 6 mg u

3 exierit7 remanserit U, exigerit μ, om a; divisionem7 dicendum r, scilicet verse add u; sume7 cape mrζ, om μ, (et Mqu) (erunt 36 q) erit pro numero punctorum umbre (recte q) per quem fiet (enim et Q, fuerit q) divisio add MQqu, AB supralin s; post...sume7 tene SUV

exierit7 scilicet in numero quotiens supralin J; per numerum quotiens mg V; post7 et illud est numerus punctorum umbre verse mg a; scilicet numerus quotiens mg k, quia umbre recte mg k

4 Deinde7 et postea J; mensura7 sume z; post...distantiam om L; te7 se I; turrim7 altitudinem SUV, ipsam T, rem α; fuerit7 distantia add μ

id est locum ubi caderet oculus tuus si caderet in terra mg k in hac distantia multiplica per 12, et productum divide per numerum (59v) punctorum umbre prius sumpte, et super illud quod exierit adde quantitatem tue altitudinis, et illud quod remanserit erit altitudo turris.

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1 hac7 ista i; distantia7 inter te et turrem add d, 48 supralin qu; per^{1} om w; 12 om Vγ; productum7 516 supralin q; per^{2}7 in V, om θ

per^{1}7 numerum punctorum et productum divide per 12 add V; productum7 in versa per numerum quotiens 144 multiplica distantiam et illam divide per 12 supralin V

2 verse divide 144 (para. 51)...umbre om nλ; sumpte7 sumptum anuwλ, scriptorum d, 36 supralin q; punctorum...sumpte7 prius reservatum punctorum umbre recte punctorum accepte α; illud7 id MTnλ, est add n; quod7 om ν, post add a; exierit7 exigerit μ, 16 supralin q

sumpte7 sit (sicut λ) 12 ad puncta sic distantia ad altitudinem mensurandam add nλ; quia dextra est recta in astrolabio, totum e contrario in chilindro. Pars superior est recta id est extensa pars inferior versa se abscinde respectu ibi et hoc pro forma mg V; id est per numerum punctorum umbre recte vel per numerum denotantem quotiens facta divisione 144 per puncta umbre verse. Quod si per puncta umbre recte vel verse non possit fieri uniformis divisio procedendum est ad fractiones equales videlicet expedientes mg k

3 altitudinis7 (scilicet V) ab oculo add d, supralin V; quantitatem ...altitudinis7 (vel γ) staturam tuam ab oculo (tuo I) ILTceimryzζ, add γ; illud om DEFJKNSUVabdfklnopstwxβγδλμν; quod7 exierit vel add γ; remanserit7 exierit nλ, om d, tibi add γ; illud...remanserit om B; illud...erit7 exibit tibi ILTceimryzζ

altitudinis7 id est stature tue usque ad oculum supralin s; id est oculi tui a terra mg k

4 turris7 quesita λ

turris/ interpolation of some 20 lines of unrelated material add α

De eodem per Solem lucentem

53. Item hoc idem fit, Sole lucente, per umbras sic: Expecta donec Sol fuerit in altitudine 45 graduum; tunc umbra cuiuslibet rei est equalis rei; mensura tunc umbram et habebis altitudinem rei. In aliis autem horis erit proportio umbre cuiuslibet rei ad rem

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1 Quartus. De eodem per umbras a, Idem per Solem (lucentum t) bt, Item aliter h, De Sole lucente per proportionem i; lucentem7 Secundarum add N; tit om rell

Tertio Sole lucente per proportionem umbre mg Dcl; Idem per umbram Solis mg b

2 Item om Onvαλ; idem7 inde v, om Jtε; fit7 de add Swδ, in add x, de supralin Js

3 Sol om Lϒ; tunc7 Item T; umbra om V, unius add h; cuiuslibet7 uniuscuiusque q

4 cuiuslibet rei7 Solis μ; rei^{1}7 ei av, om h, mensurande add ηθ, umbra add λ; equalis7 ipsi add I, sui add LTceimyzϒζ, unicuique add μ; rei^{2}7 sue altitudini q, sue add η, mensurande add ι; mensura7 mensurande α; tunc om Oε, accipias add α; rei^{3}7 in illa eadem hora add K; mensura...rei^{3} om H; rei2... rei^{3} om β

5 autem om Bi; proportio7 numerum punctorum add w; umbre om Uhvzεικ; cuiuslibet om B, recte add a; rei om P; In...rei om R; rem7 mensurande add λ

Si unum erit 12^{m}. Si 2 puncta, sexta. Si 3, quarta. Si 4, tertia. Si 5 puncta erit umbra ad rem subdupla super bipartiens quintas. Si 6 subdupla. Si 7 subdupla super quinque partinens septimus. Si 8 subsexquiplicatus. Si 9 subsexquitertius et cetera mg Dl; Si perpendiculum stat super unum punctum umbre recte, umbra rei est 12^{a} pars rei. Si super 2, erit 6^{a}. Si super 3, erit 4^{a}. Si super 4, erit 3^{a}. Si super 5, erit umbra rei ad rem subdupla super bipartiens quintas. Si super 6, subdupla. Si super 7, subdupla super quinque partiens septimus. Si super 8, subsexquiplicatus. Si super 9, subsexquitertius. Si super 10, subsexquiquintas. Si 11, subsequiundecimas. Si 12 equalis. Deinde sexquiduodecima. Sexquisexta. Sexquiquarta. Sexquitertia. Super quinquipartiens duodecimas. Sexqualter. Super septipartiens duodecimas. Super bipartiens tertias. Super terpartiens quartas mg mr; Si videlicet fuerint sex puncta in umbra recta tunc umbra ipsa erit in dupla proportione cum altitudine turris. Si vero fuerint puncta 4 fiducie tacta quia numerus iste se habet ad 12 in tripla proportione. Altitudo rei maior erit sua umbra in triplo *mg q*

The following material appears in paragraph form in the margins of mss Dlmr and in chart form as shown below in mss DEFRYbciϒ:

ad ab
bd subduodecupla
be subsexcupla
bf subquadrupla
bg subtripla
bh subdupla super bipartiens quintas
bi subdupla
bk subdupla super quinquepartiens septimas
bl subsexquiplicatus
bm subsexquitertius
bn subsexquiquintas
bo subsexquiundecima
bp equalis

Mss Eϒ add:

bq sexquiduodecima
br sexquisexta
bs sexquiquarta
bt sexquitertia
bv super quinquipartiens duodecimas
bx sexqualter
by super septipartiens duodecimas
bz super bipartiens tertias
b& super terpartiens quartas

sicut in eadem hora est proportio numeri punctorum umbre recte ad 12: ut si fuerint 6 puncta in umbra recta, que sunt medietas de 12, erit tunc umbra medietas rei in altitudine: et sic de aliis.

54. Sed ad hoc quod scias omni hora accipere umbras, oportebit

---

1 proportio om c; umbre...proportio om oν; punctorum om EFJLSTUVbdefiklmnrtyzβγζμ, unius add P; rei...umbre om X; recte om CLO; 12 om γ

Idem intellige de umbra versa et de re eius est. Et de numero punctorum eius id est 12. Si autem vis certificari de proportione umbre sive de punctis eius per quadrantem verso latere sinistro ipsius ad Solem, fac radium Solis intrare per utrumque foramen simul et si perpendiculum cadat super lineam mediam, erunt equales umbre rei et inter se invicem. Si non cadat super latus illius umbre super cuius latus cadit est minor re secundum proportionem punctorum ad 12 et alia maior secundum eandem proportionem mg a

2 ut] et TXcfmyβγζ, vel ɛ, om d; ut...fuerint] et n, ut sint λ; in om nλ; recta om LY, terre add V; de om TXa; 12 om γ; erit] et μ

in primo gradu Arietis et in primo gradu Libre mg c

3 umbra om Q, rei supralin G; de...medietas om β; rei om E; altitudine] et in longitudine α, ad AB add μ; sic om U; sic...aliis] ceteris oθ; sicut in eadem...aliis om, add post paragraph 54 q

de motu particulo Aries, Taurus, Gemini in istis ascendit etiam sic. Septemtrionalia Cancer, Virgo in istis descendet et sic septemtrionalia Libra, Scorpius et Sagittarius in istis descendit et sic meridionalia Capricornius, Aquarius, Pisces in istis ascendet et meridionalia sic mg c; Facies etiam hoc modo. Permittas intrare Solem in hora qua vis mensurare rem per ambo foramina. Et vide ubi cadit perpendiculum. Quia aut cadit in umbra recta aut reflexa. Si in recta vide que est punctorum ubi ceciderit perpendiculum proportio ad 12 et eadem erit umbre rei ad rem. Si vero ceciderit in versa reducas in rectam sicut docet post istud capitulum. Et que erit proportio illius ad 12 eadem erit umbre ad rem mg s

4 Sed] Si D; hoc om a; quod] ut JShikstyλ; scias] in add Snwyδ; accipere] recipere g, accipias wδ; umbras om α

te mutare umbram rectam in umbram versam et e contrario.

Inventio umbre recte per umbram versam

55.Si autem vis ex umbra versa habere numerum punctorum umbre recte, per numerum punctorum umbre verse divide 144, et illud quod exierit post divisionem erit numerus punctorum umbre recte.

Ad inveniendum umbras versas per umbram rectam

56. Si vis invenire umbras versas per rectam, divide 144 per

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1 te om A; mutare om Zj; umbram^1 om μ; umbram^2 om ABDEFGHKLOPTUVWXZ abdefghijlmnoprxzγζημν; rectam...umbram^2 om κ; in...versam7 numeri β; contrario7 converso nzβ, commutare add Zj; Sed...contrario om MQu

id est scire mutare mg k

2 De inventione unius umbre per aliam a; recte7 verse s; umbram om N; versam7 rectam s, Secundarum add N, et e contrario add kst; tit om rell

3 vis om Vβ; ex7 ab o; umbra om X; versa7 recta μ; habere7 accipere v; numerum punctorum7 puncta ILTceimryzζ

umbre recte quia sint se habet numerus ad numerum sit se habet alteri rei ad umbram vel e contrario mg c

4 numerum punctorum7 puncta q; umbre om nv; per...umbre supplied in mg a, om d; recte...umbre om W; divide7 in add nv, supralin s; illud om ILTceimrzζλμ

5 exierit7 erit ε, exigerit, exemplum add μ; post7 per λ; divisionem7 dicendum r, summe et add wδ

6 Inventio umbre verse per umbram rectam. Rubrica δ, tit om rell

7 Si7 autem (etiam g) add gy; versas om A; per7 umbram add θ; rectam7 totam d; divide7 in add n

144 est quadratum cuius radix est 12 mg t

numerum punctorum umbre recte, et exibit tibi in divisione numerus punctorum umbre verse.

De turri inaccessibili mensuranda

57. Si aurem turris fuerit inaccessibilis mensuranda, vide summitatem eius per ambo foramina, et respice numerum punctorum

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1 recte7 verse *np*; Si...recte *om* *zβ*; tibi *om* *ILTehirzζ*, numerus *add* *μ*; in divisione *om* *α*; numerus *om* *p*

2 umbre *om* *s*; verse *om* *sα*, et cetera *add* *θ*, *paragraphs 60-62* *add* *(misplaced)* *h*; exibit...verse7 sufficit *y*, *om* *n*

3 De mensuranda turris inaccessiblis bona regula *D*, De mensuranda turris inaccessibilis altitudine *EK*, Sequitur bona regula de mensuranda (mensurata *e*) turri inaccessibili *LTcei*, De turri inaccessibili metienda (mensura *bh*) *Qbhqu*, Quintus: De altitudine inaccessibiliter *a*, De mensuranda turribus inaccessibilibus bona tertia *l*, De altitudine inaccessibili *mr*, Ad habendam mensurationem alicuius turris vel alterius rei inaccessibilis *s*, Idem quando res est inaccessibilis *t*, Capitulum de mensuratione alicuius turris inaccessibilis *x*, De mensuratione alicuius turris inaccessibilis per quadrantem *β*, De mensuratione turris inaccessibilis *ϒ*, De turri inaccessibili invenienda mensurando *ε*; mensuranda7 per quadrantem *add* *ACGHOPRVWYικ*, caput *add* *j*; *tit* *om* *rell*

De mensuranda turri (turris *l*) inaccessibili (inaccessibilis *l*) bona regula (tertia *l*) *mg* *cl*

4 turris7 res *λ*; inaccessibilis7 in *add* *T*; mensuranda *om* *Jy*; vide *om* *δ*

infra ad cartam 57 altitudo vero rei *mg* *q*

5 summitatem7 A *supralin* *ks*; eius *om* *ν*; ambo7 duo *o*; foramina7 quadrantis *add* *CRYνθικ*, id est tabularum *add* *h*; vide...respice *om* *F*; numerum *om* *i*

umbre recte sicut prius, et pone signum D in loco in quo tu stas in hora considerationis. Et intellige quod foramina debent esse valde stricta, per que debet transire radius visualis ad rei altitudinis comprehensionem, aliter tam cito esset error.

58. Consequenter elonga te a turri vel appropinqua ei secundum lineam rectam, et iterum respice altitudinem turris, et quere numerum punctorum umbre recte ad hunc situm in quo secundo stabis, et pone

---

1 umbre om bβ; recte7 verse dq, recipe t, om M; sicut7 ut ITeimryζ; sicut...et7 ut z; signum om β; D om BFJPSUVZabdfntαδ; loco7 vel add β; in quo7 ubi vzα, om R; tu om ιμ; tu stas7 steteris ILTceiyzζ, steterit mr; in^3 om m

2 hora7 ipse Cθ; esse om θ; valde om N

illegible note mg K

3 stricta7 parva Cθ, om β; que7 quod AH; debet7 Sol add GOWpα; transire7 vel (etiam Gα) add GOWpα; visualis7 visibilis DFJadirs δεζ, solaris v

4 comprehensionem7 deprehensionem MR, prehensionem N; aliter7 eius add N, enim add Vg; tam7 quoniam ABDEGHIKQRTWYZbcdfhijmoprxzζικν, enim quoniam Cθ, quam Melsuvβε, enim η, om L; esset7 contingeret UV; Et...error om nλ

5 Consequenter7 Continenter n, Sequenter w, de add e, te om e; a7 de Y, om In; turri om In; vel7 et I; appropinqua7 propinqua aevεθ, accede α; ei7 ad eam α, isti θ, eum μ, om Oyz; secundum7 in μ

6 respice om β; turri...respice om G; turris7 rei mensurande λ, om JSUVkst

7 umbre om F; recte7 turre f, verse q, om X; situm om z, secundum add DLUabdilnstyδζλ; quo7 nunc add v; secundo om JLUZksδζ; stabis7 steteris MQZjuη, (tu fλ) stas SUVdfhkntλ, sicut prius supralin q

ad 12 eadem igitur utriusque stationis per se mg 1 signum C in illo loco, et mensura quot sunt pedes inter duo signa, et retine illud; postea subtrahe numerum minorem umbre recte de maiori, et servetur differentia; et distantiam inter dicta duo loca multiplica per 12 et productum divide per differentiam prius acceptam,

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1 C] E cζ, aliud p, om FJLSUVabdntβμ; illo] hoc γ; in...loco om LTceimr yzζ; mensura] considera mrζ; quot] que a, quod no; sunt] sicut pes R, om Fw; pedes om mr; inter] illa add BIq, te (se w, om o) et add JNSUVotwδ; duo] loca illa sive nλ, om Lak; signa] puncta μ, C et D add Eqyβγ, CD add Tceisz, C et D supralin DKkl

2 retine] tene BIwδ, serva LTceimrzζ, remove η, 20 supralin q; subtrahe] illum add v; numerum] punctorum add BP; minorem om aη, de maiori add U; umbre om η; recte] turre f, verse q, om n; et...recte om μ; de om TUz

3 maiori om TUz; servetur] sumatur d, intuetur z, mensuretur θ; differentia] 2 supralin q; et^2] Deinde CEIKLTcemyzβγζθλ, (ad η) illam add MQZjquη; distantiam] que est add MQZjquη; inter] hoc add Skwδ; signa...inter om α; dicta] predictam B, haec UVnλ, om CEIKLQT ceghimrβγ, haec add s; duo] et op, om θ; loca] signa Q, puncta C et D q, dicta add n, quam distantiam add v, signa supralin Z, 20 supralin q, CD supralin s

que est in astrolabio a dextris versa sinistris in quadrante e contrario ut similiter declaratur mg V; scilicet accepta per pedes mg t; Idem in umbra versa sed quod ambo puncta revolvent per 144 et hoc facto minor revolutio, quotiens que exibit ex maiori numero punctorum deducatur de maiori exeunte de minori numero punctorum revolutio, et sit talis in 12 punctis in quadrante numerus quotiens est 12/ de 11. 13/ de 10. 14/ de 9. 16/ de 8. 18/ de 7 punctis 20/ de 6. 24/ de 5. 29/ de 4. 36/ de 3. 48/ de 2. 72/ de 1. 144. Sed in maiore numero punctorum veluti.xi.x.ix. puncta non bene ex errore tibi. Sed solum in minoribus ut 8.7.6.5.4.3.2. primo gradus umbre verse. Si 2 est vero quia ostendet quod distantia sit tanta quod intercipi? quod non possit fieri parvo numero mg V

4 per om U; 12 om Uγ et] per add v; productum] 240 supralin q; divide per] dividatur d; differentiam] punctorum add d; prius om d; acceptam] sumptam ILTceimrzζ, tactam f, 2 supralin q

acceptam] per 2 umbras add Zj; scilicet inter duo umbras supralin K; inter 2^o umbras vel stationes mg K; scilicet punctorum umbre mg t et illi quod exierit adde quantitatem tue altitudinis et quod remanebit erit altitudo turris.

De turri supra montem mensurandi

59. Quod si tu steteris in valle et altitudinem alicuius turris

---

1 exierit7 exigerit μ, supralin q; adde7 ad add αθλ; altitudinis7 8 supralin q; tue altitudinis7 tuam ABCGHOPRWXYghopvx ζεικλν; et²7 istud add I; quod7 exibit vel γ

illi7 scilicet numerus quotiens supralin K; quod7 altitudo turris tuum habeat a loco turris in directo oculi add α

2 remanebit7 proveniet B, exibit I, ibi add Kγ; erit7 ibi β; quod... erit7 exibit LTceimryzζ; altitudo7 quantitas v, AB supralin s; turris7 rei mensurande λ, AK supralin K, 128 supralin q, erit hec figura pige comorouo add μ

remanebit7 scilicet ab oculo tuo ad terram supralin q; dimensio turris in monte mg Dl

3 Secundo de mensuratione turris inaccessibilis in monte OX, Sextus: De altitudine existente in monte a, De turri in valle existente b, Item aliter h, De turri stante in monte mensuranda δ, tit om rell

4 Quod7 et U, Sed α, om P; tu om IJLTcefghimruwζν; alicuius7 illius B, om ILTceimrζ; turris7 rei λ

Poteris tunc per utrumque latus umbre facilius rei altitudinem sic metire. Si enim cadat filum super latus umbre recte, quota pars fuerint puncta que sunt inter filum et latus dextrum qudrantis numerus dividitur, tota pars erit distantia inter pedem mensoris et radicem altitudinis eiusdem altitudinis addita prius eidem distantie simili parte mensure sive stature ipsius mensoris ab oculo usque ad plantas accipe ut si 3 sicut puncta predicta distantia est quota parte stature tue erit quarta pars altitudinis mensurande. Si vero cadat simul latus umbre verse quot remanserunt usque ad latus quadrantis sinistrum addende nam quota pars fuerit duodenarii. Tota pars erit altitudo distantie supradicte addite prius eidem distantie totiens statura tua quot fuerint unitates in numero denominante partem huius ut si fuerit tertia pars addatur statura tua tres, si quarta quatuor si mediabis et sic de aliis a distantia igitur mensurata factaque additione stature ut dictum est. Nota erit quantitas altitudinis. Vel aliter et facilius respice per utrumque foramen aliquem punctum in re mensuranda perpendiculo cadente super lineam AB que est in sinistro quadrantis et nota punctum illum.

Postea respice altitudinem rei ab eodem loco et si cadat filum super umbram rectam quota pars fuerint puncta duodenarii tota vel tanta pars erunt distantia sive aliquo addito altitudinis que est a puncto notato usque ad verticem rei. Si non cadat super quod latus tota pars erit altitudo a dicto puncto sumpta? dicte distantie si non aliquo addito sumpte quota pars puncta sunt duodenarii mensurata igitur sola distantia taliter sumta non erunt tibi quantitas altitudinis in puncto usque sursum. Si igitur res sit in plano addas illi quantitati scilicet altitudinis a puncto sumpte tuam staturam scilicet ab oculo ad plantam habebitur totam rei altitudinis infallibiliter. Et secundum hoc posset mensurari? 48 capitulo astrolobi sed lictatur? non videatur sed? servetur? (*Messahallah*). Si aliter intellige capitulum illud quodlibet incipit *Si autem res non sit* in plano fac ut dicebatur super capitulum 2 (*para*. *50*) *mg* *a* stantis in monte volueris metiri, considera primo altitudinem montis per duas stationes secundum formam prius immediate dictam. Deinde considera altitudinem turris et montis simul, et remove altitudinem montis de altitudine tocius aggregati simul, et residuum est altitudo turris.

---

1 monte7 et si add μ; volueris metiri om Υ; primo7 prius NS; montis7 turris o, (et turris Gp) simul add Gep

Divisio turris in monte mg c; Hec est usque ad summitatem previsam. Tunc mensurande cadente perpendiculo super 45 gradus mg u

2 formam7 iam add SUV; prius om g, acceptam vel add x; immediate7 in medietate a, om UV; secundum...dictam7 per modum immediate predictam ILTceimryz ζ

sub per duas stationes sicut dicitur mg u; Scilicet similiter proxime et subaudi etiam quod facienda est, tota operatio scilicet multiplicando et dividendo et similiter addendo staturam, et altitudo turris et vera altitudo montis per se prima. Deinde considera altitudinem montis et turris simul subaudi eadem operatio faciendo ut sciatur eadem altitudo utriusque simul et tunc remove altitudinem minoris et ceteris quod intellige quando altitudo montis est minor mg u

3 primo...considera om h; altitudinem om v; turris7 rei mensurande λ; montis7 per eadem considerationem add μ; per...montis7 et turris CRYθικ; simul7 similiter n, om λ; remove7 vel subtrahe add q; turris...altitudinem7 montis per se et eam subtrahe Gp, om ε; et move? mg a

simul7 per eandem considerationem (vel formam Dl) add Dfa, supralin l, per (in z) eandem doctrinam add EIKLTceimryzγζ, et hec per 2 stationes add j, per eadem foramina supralin q

4 montis om dpℓ; per...montis om β; de7 ab Kfhβ, om Mℓ; altitudine om Mℓ; tocius om dλ; aggregati7 aggrega a, om v; simul om SVmrζ, altitudo7 AB supralin s

dimensio altitudinis per virgam et oculum mg l

5 turris7 montis z, rei proposite mensurande λ, precise add CRYvθικ, et cetera add y; et...turris om Υ

De mensuranda altitudine sine quadrante per virgam

60. Si autem non habeas quadrantem et velis mensurare altitudinem, accipe unam virgam et erigatur super planum perpendiculariter: que habeat notam quantitatem; et tunc pone oculum tuum iuxta terram,

---

1 De eodem inveniendo per virgam A, De eisdem mensuratione per virgam B, De altitudinibus (altitudine CG) rerum sine quadrante per (om X) virgam (om X) CGHRXY, De altitudine mensuranda per virgam sine quadrante K, De eisdem mensuratione altitudinis sine quadrante per virgam MQjquη, Secundarum (Caput Tk) de mensuranda altitudine sine quadrante NTk, De mensuratione (ad alicuius turris β) altitudinis (rerum x) sine quadrante per virgam Wwxβ, De eodem sine quadrante per virgam Z, Septus: De altitudine mensuranda per virgam a, Item aliter sine quadrante per virgam h, De eodem sine quadrante mr, De mensuratione altitudinis sine quadrante s; Mensuratio rei sine quadrante t, De mensurationibus sine quadrante ε, De rerum altitudine sine quadrante per virgam est in capitulum ι, De altitudinibus per virgam κ, Quo modo aliquid mensurari possit sine quadrante in altum latum longum et profundum λ; De7 Sequitur de Lce; mensuranda7 rerum add DELbceilΥ; tit om rell

quadrante7 De mensuranda altitudine supralin s; De mensura altitudinis per virgam et oculum mg D

2 autem om mrζ; et7 tamen add I; mensurare om a; altitudinem7 AB add ETceizζλ, supralin Lkl, DE add mr, quadrante add μ

altitudinem7 alicuius rei (AB K) add CRYavθι, mg K, sine quadrante add F, rei add QZjquη; de mensuratione altitudinis per virgam et oculum mg c

3 virgam7 DE add ETceiyzζλ, supralin DLls; et7 ipsum add η; et erigatur om ν; planum7 palmum ce, BC add ETceiyz, supralin Dkls, AB supralin L; super planum7 eam g

4 oculum7 C add ETryζ, supralin Lkls, E add ci; iuxta7 ad U, om V

terram7 removendo se a virga mg u

movendo caput huc et illuc, donec radius visibilis transeat per summitatem virge et per superiorem partem altitudinis turris.

61. Deinde considera quantum est inter locum super quem est oculus in hora considerationis, et inter inferiorem partem altitudinis rei, et istam distantiam multiplica per quantitatem altitudinis virge, et totum illud productum divide per distantiam

---

1 movendo om j; caput om j, tuum add S; donec7 tunc, corr in mg a; visibilis7 visualis RWgkzγδθικλν; per om o

Nota hoc non est necesse stando (?) tantum? summitatem? (?) accipiat tantum spatium retro se (?) ita est oculus ad tantum? altitudinem mg t

2 summitatem om o, E add mrζ, supralin Kkls; per om IJg; et per7 a terra ad λ; superiorem7 super J, A supralin D; altitudinis om θ; turris7 rei (mensurande λ) SUV λ, om T, A add mrζ, supralin Kks

3 quantum om ε; super7 per J; quem om ε

4 est oculus7 es n; oculus7 locus W, C (cuius z) add Eiyz, supralin DKLkls, E add Tce, tuus add BMOQXZadgj αη; hora7 tue add η; considerationis7 20 supralin q; inter om q; inferiorem7 B add ELei, supralin Kkls, BC add T

5 altitudinis om ILTceiy, ED supralin k; rei om SUV, mensurande add IMQZjq η, supralin Ku; istam om T, BC supralin q; distantiam om AGHMORWZghquv αεικ, CB add Ei, supralin ls, C et B supralin k, EB add PTcej; quantitatem om d, DE add Eceiz, supralin l, D add T, 8 supralin q

6 altitudinis7 altitudinem d, illius β, illius add K; rei...altitudinis om X; virge7 DE supralin q; totum om g; illud7 ita λ; productum7 160 supralin q; divide7 multiplica U, deinde v; per7 et f; distantiam7 DE add ETcei, C supralin L, CD supralin klsz, 4 supralin q

et si secundum multiplicationem et divisionem hoc scire volueris. Vide quotiens distantia inter oculum et pedem virge continet in plano a pede altitudinis mensurande usque ad oculum et tociens virga continebitur in altitudine mg k inter oculum et virgam, et exibit in numero denotante quotiens quantitas altitudinis rei.

Secundarum. De eodem per virgam et umbram

62. Item aliter id ipsum scilicet per rerum umbras: Cum enim aliqua res, cuius altitudinem volueris cognoscere, umbram fecerit super planum, accipe virgam erectam perpendiculariter super planum

---

1 inter] minus *y*; oculum] C *add z*, *supralin L*, CD *supralin q*, E *add Tcei*, tuum *add ISUVg*; virgam] D *add ETceiz*; in] de *jθ*; denotante *om nλ*; quotiens] quota est *O*, *om nλ*, sit *add v*, quota est *add q*

hec est inter locum super quem cadebat oculus in hora considerationis *mg u*

2 quantitas] AB *add ETceiqz*, *supralin Dkls*, est *add w*, illius *add β*; altitudinis *om f*, illius *add K*; rei] est *add U*, erit *add y*, fuerit *add q*, mensurande *add λ*, 40 *supralin q*, altitudinis rei] sit altitudo rerum *μ*

3 Item aliter per rerum umbras *h*, Idem aliter *t*, De altitudine rei habenda per virgam et umbram *δ*; Secundarum] Octavus *a*; *tit om rell*

per virgam et umbram *mg Dl*

4 aliter] per *add a*; id] ad *LTWXoyθ*, hoc *Yη*; ipsum] scire poteris *add I*, mensurandum *add λ*; scilicet *om Ngmqrζ*; id...scilicet *om g*; Item...scilicet] Sive videlicet *q*; per *supplied in mg a*, *om W*; umbras] poteris scire *add E*; Item...umbras *om SUVkwδ*

5 cuius] alicuius *α*; cognoscere] scire *Ih*, habere *q*, per *add n*; fecerit] sta *n*

6 planum^1] CB *add E*, et *add n*, AB *supralin L*; accipe] te *add a*; virgam] DE *add ETceimzζ*, *supralin klrs*, BC *supralin K*; super^2] prope, *corr in mg a*, *om SUV*; planum^2 *om SUV*, CB *add Tciz*, *supralin ls*, AB *add e*; accipe...planum^2 *om py*

prope terminum umbre rei mensurande, ita quod una pars virge cadat in umbra et alia pars extra umbram; et nota locum in virga ubi umbra incipit tangere (60r) virgam, et per quantitatem virge, que est inter tactum umbre et planum, multiplicetur quantitas tocius umbre que est inter inferiorem partem rei mensurande et conum umbre; et productum divide per quantitatem umbre que est inter conum umbre et virgam, et exibit altitudo rei mensurande.

---

1 prope7 super f; terminum7 terram fw, om θ; umbre om bϒικ; ita7 scilicet add b; pars om lt, scilicet add s; cadat om ν

2 pars om BCDEFJKLNSTUVcdefghimnorwxyz βγδζμν; locum7 in umbra add o; in^2 om J; virga om J, DE add mrζ, E add z, CE supralin DKkls; umbra^{2}7 virga UVg, om p

Idem si tota caderet in umbra vel de sinistra tua fac virgam mg V

3 tangere7 tetigere d; virgam7 umbram VUg, om h, e contrario add η; quantitatem7 DC add Tceiz, DE supralin KLkls, 8 supralin q; inter om Tcez θ

4 tactum7 contactum CGMQRTYZgjpquvι, radium η, virge add y; et7 que z; quantitas7 CB add ETmzζθ, supralin Dklrs, EB add cei; tocius7 ipsius ι, om d; umbre^2 om V, 20 supralin q; est om ε

planum7 id est terra add α

5 inter om d; rei7 B supralin Dkls; conum7 contactum Mls, terminum Oa, communi y, totum θ, C add DETceilz θ; umbre7 virge w, virge add ϒ; et...umbre om a; productum7 per C dictum est θ, om L, CD supralin k, 160 supralin q

6 divide7 deinde (dividatur L) AL; quantitatem7 CD add Eθ, supralin ls, ED add Tce; umbre om LTceθ, 4 supralin q; et...umbre^1 om Q; est om T; inter7 terminum add gα; conum7 contactum AEIJLNPQTWZbcefgijoxyz αβγδεηθν, tactum UVdq, terminum Xa, conum vel terminum S, contactum vel conum u; umbre^{2}7 virge vη, om I, C add z, supralin kls; que... umbre^2 om w; productum...et^1 om D; virgam7 virge MQq, pedem u, D add z, supralin kls

umbre^{2}7 id est inter conum umbre add α; Est quatuor in palmo digiti. Quatuor in pede palmi. Quinque pedes passum faciunt; passus quoque centum virginti quinque stadium. Post hec miliare octo facit stadia. Duplicatum dat tibi leucam mg t

7 altitudo7 quantitas g, AB supralin Dkls, 40 supralin q

De eodem per speculum sine quadrante

63. Item aliter satis curialiter: Ponatur speculum in plano et procede huc et illuc donec videas rei altitudinem, et per altitudinem

---

1 De eisdem mensurationibus per speculum B, Iterum aliter satis curialiter potest (ponatur E) idem haberi (habere E) DEl, De altitudine mensuranda sine (om KW) quadrante (om KW) per speculum GHKRWYικ, Item aliter satis curialiter Lcei, De altitudine rei per speculum mensuranda MQjquη, Secundarum. De eodem per speculum N, Item satis aliter per speculum T, Nonus: De eodem per speculum as, Idem per speculum satis curialiter b, Item aliter h, Mensuratio per speculum t, De mensuratione eiusdem per speculum x, De mensuratione alicuius altitudinis per speculum β, Item aliter de eodem subtiliori modo γ, De altitudine turris per speculum invenienda ε; sine quadrante om CZkδ; tit om rell

Item per speculum mg 1

2 Item7 Idem I; aliter7 per speculum a, om Iν; curialiter7 bene de eodem y, om β, per speculum add B, de eodem add ELTeimrzγζθ, scire poteris de eodem add I; Ponatur7 unum add FJNUVafknstδλμ; speculum7 E add E, supralin DLls, C add ceizθ; in om η; plano om η, BC add Emrzζθ, supralin DLkl, BE add ce

3 procede7 vel add q; videas7 in speculo add BGp, supralin K; rei7 AB supralin ks; altitudinem^{1}7 FC add ETce, supralin DLl, C supralin k; per7 speculum add B; altitudinem^{2}7 distantam U, FG add θ; et...altitudinem^2 om Vcdeθ

altitudinem^{2}7 in medio speculi quo stas tu multiplica planum inter basim rei mensurande et speculum per distantiam oculi tui a terra. Et productum divide per distantiam inter pedem tuum et speculum et exibit altitudo rei. Seu dividas planum per distantiam a speculo ad pedes mensoris et productum multiplica per distantiam oculi tui a terra. Et exibit altitudo turris supralin q; videas7 et ut circinus? fiat sta in tali situ quod angulus incidentie et reflexionis sive punctus imaginis supreme? partis cadat in? orizonte sive in extremo speculi. In medio est incertiorem mg a oculi tui a plano multiplicetur quantitas que est inter inferiorem partem altitudinis et speculum et productum dividatur per distantiam inter pedem tuum et speculum, et exibit altitudo rei mensurande.

---

1 oculi7 F add Tcezθ, supralin Dkls, FC add mrζ, ED supralin L; tui om B; a7 in Fz; plano7 E add c, BC add z, C supralin Dls; quantitas7 EB add Tc, supralin Dk, CB add czθ, supralin ls; est om μ; inferiorem om UV

multiplicetur7 Secundum quantitatem altitudinis tue supralin V; Hoc est a planta pedis useque ad oculum mg u

2 altitudinis7 B add ETcemrzζθ, supralin Dkls; speculum7 E add Emrθ, supralin Dkls, C add Tceζ; productum7 prout dicendum est θ, speculum add T; distantiam7 que est add SUV

que est a sinistro latere que umbra est folio proximo illi vel sic accipe latere? versa ut? inveni talem varietatem. Secundum prope loquendo quod hac recta debet nominari umbra versa seu extensa versa istius varietatis est quia auctores librorum locunt de lateribus quadrantis prout eam figuram scilicet limbum versus celum hoc experiendo et operendo Soli limbus est versus terram mg V; scilicet rei mensurando mg u

3 pedem7 C add Eθ, supralin Dlrs, D add z, E add ce; speculum7 C add i, E add ETcezθ, supralin Dkls; altitudo7 AB add ETcθ, supralin DLkls; rei om e; mensurande om e, illudze clesezovi add μ

mensurande7 Explicit prima pars de usu quadrantis in geometrias scilicet altimetria add a, ut patet in figura sequenti add z, Si vis profunditatem putei metiri ab uno latere putei respice cum quadrante terminum oppositi lateris in profundo putei et notetur quantitas diametri latitudinis putei et accipiatur hora considerationis numerus punctorum umbre recte in latere quadrantis et multiplica quantitatem diametri latitudinis putei per 12 et divide per numerum punctorum umbre recte et exibit profunditas putei. Vel si non habes quadrantem pone virgam que in ore putei vice diametri coaptetur et aliam virgam secundum longitudinem stature tui diametre ortogonaliter superponas et per summitatem virge oppositam profunditatem respicies et nota punctum in quo radius visualis secat diametrum et multiplica virgam in diametrum et productum divide per minorem diametri partem et exibit quantitas profunditatis add λ; per quantitatem inter oculum tuum et speculum mg l

Distinctio secunde partis

64. Secunda pars mensurandi huius doctrine, que est planimetria, habet duas partes: prima est de arte mensurandi planum in longum tantum, secunda in longum et latum. De prima igitur prius dicendum.

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1 Secunda pars. De planimetria A, De planimetria et primo per quadrantem in longum tantum B, Sequitur de planimetria et primo de mensuratione (mensuranda HR) plani in longum (longitudine HR) CHRι, (Sequitur c) De mensuratione plani que est secunda pars (huius operis N) DELNbceilsγ, Sequitur secundo de planimetria in longitudine G, De planimetria et primo de plano in longum K, Secundo de planimetria et primo in longum tantum cum quadrante MQ, De planimetria OSWhmrζ, De mensuratione plani sive altitudine T, (Sequitur κ) Secundo de planimetria et primo de mensura plani in longum Yκ, De secunda parte mensurandi Z, Incipit secunda id est de planimetria a, De mensura planorum g, Secundo de planimetria et primo in longum j, Sequitur de planimetria n, De planimetria primo in longum tantum cum quadrante q, Secunda pars huius tractatus que dicitur planimetria t, Secundo de planimetria et primo in longum u, Secundo de planimetria et primo de mensuratione plani in longum x, Secundo. De planimetria et primo de plana in longum tantum β, Sequitur de mensuratione planimetria ε, De planimetria et primo in longum η, De mensura plani in longum λ, tit om rell

2 mensurandi om FIPUdεμ, pars add V; doctrine7 operis κ, om LTceimrζ; est7 dicitur v; planimetria7 AB rei mensurande add e, oratio add v

Secunda pars mensurationis rerum scilicet planimetria et primo in longum tantum. Deinde in longum et latum id est Si autem vis et cetera mg (para. 63 c) Dcl

3 duas7 3 R, om T; arte...planum7 mensuratione plani (om e) ILceimryzζθ; prima...planum7 plani T; longum7 locum v

4 tantum om JNSUVns; secunda7 est de arte mensurandi add NSUV, est add θ; et7 in add OX; De om o; igitur om d; prius7 primo KMPZcoβγ, principio d, om BTrλ, est add BILNPSUVZacekmnorsvwxzδζθμ; dicendum7 dicto o, agendum z; De...dicendum om OTα

De mensuratione plani qui est quarta pars

65. Cum volueris mensurare longitudinem alicuius plani cum quadrante, sta in uno termino plani, et respice alterum terminum plani per ambo foramina, tenendo conum quadrantis, in quo est clavus cui filum annectitur, iuxta oculum, et conum quadrantis per quem intrat

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1 Primus. Canon de longitudine plani mensuranda per quadrantem a, De mensuratione plani k; quarta] secunda δ; tit om rell

2 Cum] Si y, igitur add SUVns; longitudinem] longum U; alicuius om ILT ceimrzζθ; plani] planiciei Rικ, om U; cum om B

Consequenter dicendum est de mensura conium et de mensura rerum altitudinum. Secunda pars mensurandi huius doctrine que est planimetria habet 2 partes. Prima est de arte mensurandi planum in longum tantum. Secunda in longum et latum. De prima igitur dicendum est prius et iam dictum est. Et incipit ibi. Cum volueris ubi ymagine est hec signa (post area, para. 76) add N

3 quadrante] quantitate α, om B; sta] intra κ; termino] punctum z, om e; plani^1]vel in turri add V; cum...plani^1 om L; alterum] alium v; plani^2 om L; et...plani^2 supplied in mg a, om R

4 per om d; foramina] quadrantis add c; tenendo] per add W; quadrantis] A add EIKLTceimryβγζθ, annulum supralin q; sed Sol add μ; clavus] terminus (vel clavus supralin) a; cui] infixe sunt tabule sive cui add η

5 annectitur] appenditur n; conum] C add Tcei, E add Ey; quadrantis om c

tabula cursoris versus planum mensurandum. Tunc perspecto termino plani mensurandi accipiatur numerus punctorum umbre recte, et per 12 multiplicetur quantitas ab oculo tuo usque ad pedem, et productum divide per numerum punctorum umbre recte et exibit quantitas longitudinis plani.

---

1 cursoris om W; Tunc7 Et n; perspecto7 percipito α; termino7 numero β, fine η

(tenendo conum quadrantis c) Et nota quod hoc (om κ) modo quadrantem tenendo (ponendo Kkκ) fit (om κ) de latere umbre recte (versa Kkκ) versa (recta Kkκ) et e contrario (de latere umbre verse recta et sic intellige non errabis Dcl) (alias intollerabilis esset error Kkκ) mg (para. 63 c) DKckl, add post accipiatur, l. 2 κ; Nota inspiciendo sic per conum quadrantis ubi est clavus quod duc umbram punctum dicetur umbra versa et e contrario mg t

2 mensurandi om Pθι; Tunc...mensurandi om Eqt; accipiatur om R; recte7 terre f, verse nqδλ; et7 sed d, tunc add q; 12 om γ

3 multiplicetur7 multiplica DEFIKLNSUVabcdeflmstyzβγζθλμ; quantitas7 quantitatem DEFIKLNSUVabcdeflmstyzβγζθλμ; quantum Z, que est add UV; usque om ITmrθ; pedem7 terram Fa, tuum add Lnλ; productum7 26 supralin q

4 numerum7 quantitatem numeri v; ab...punctorum om μ; recte7 verse nλ, 4 supralin q; quantitas7 sit add θ

5 longitudinis7 24 supralin q; plani om α

De eodem per virgam perpendiculariter erectam

66. Vel sic sine quadrante: erigatur virga una perpendiculariter in uno termino plani terre vel aque, et causa exempli vocetur planum

---

1 De mensuratione plani per virgam B, (Secundarum N) De eodem mensurando (om HZ) sine quadrante per virgam (capitulum ι) CGHKNRYZ ικ, (Item Qju) de eodem aliter sine quadrante MQjqu η, De mensuratione plani sine quadrante per (om W) virgam (om W) Wx, Secundus. De eodem per virgam a, Idem aliter b, Item aliter h, Idem sine quadrante t, tit om rell

2 sic om p; una om z

3 uno om h; aque7 vel turri add V; terre...aque om B; et7 ex add δ; causa7 gratia α, differentia add g; exempli7 terre add Rsv; planum om Tθ

Ita tamen quod oculus tuus non erit in linea AE per quam terminus longitudinis plani IA venit ad perpendiculum sed super eam elevatur in aere aliquantulum plus quam speculum. Et ad hoc ymaginare in supradictas figuras quod linea CD opponitur angulo E sicut nunc angulus A a puncto D significet oculum et linea CD significet distantiam eius a linea EB acceptam secundum lineam perpendicularem et terminabitur linea CD ad lineam egredientem a puncto E ymaginabile elevatam in aere directe super lineam EB cum qua scilicet linea ymaginabilis constituet angulum rectum et tunc angulus AEB et angulus DEC sunt equales sicut angulus incidentie et ut melius istam equalitatem videas ymaginare quod si triangulus DEC poneretur ex parte opposita ita? quod linea CE adderetur in puncto E linee EB in continuum et directum et significet distantiam pedis tui a speculo E iacente in plano et linea DC altitudinem oculi tui a plano et DE radium visibilem in linea AB altitudinem mensurandam sicut debes ymaginari circa ultimum canonem partis precedentis predicti duo anguli essent equales similiter et hic et ideo hoc eodem modo per CD multiplicando EB et productum dividendo per CE habebis in numero quotiens quantitatem longitudinis plani scilicet AB sicut ibi quantitatem altitudinis mg a

BE, et virga erecta AB, et virge AB insistat alia virga equidistanter plano, constituens cum virga AB angulum rectum, et sit virga CD.

67. Postea iuxta virgam erectam ponatur oculus tuus, et respiciatur alter terminus plani mensurandi, et notetur locus in

---

1 BE7 BC AIJNSwβζη, EBC T, B X, AB n, DE ι; erecta7 recta a, om MQZgq; et...AB^{1}7 cuiB, om ezαι; virge7 erecte add Kyβγ, scilicet erecte supralin s; AB^{2}7 erecte v, B α; et virge AB om μ; insistat7 CD add K, virga ED add β; alia7 verbi gratia AB add α, aliqua add η; virga^{2}7 ED add E, FD add e; equidistanter7 a add NPmrζ

2 constituens7 continens I; virga^{1}7 umbra f, om mrζ; AB7 AD f; rectum om dfκ, rerum add O; sit7 summitas rei recte add T; virga^{2}7 secunda add I; CD7 ED Bη

3 virgam om e; erectam om j; tuus om dhw

id est in summitate mg k

4 respiciatur7 post hoc add η; alter7 altitudinem α, alicuius ε; terminus7 turris α, numerus θ; locus7 punctus ABCHJMNOPQRUVWXYZghjoq xαεηικν, pes p, vel punctus add I

virga CD per quem transit radius visibilis, et sit ille punctus in linea virge CD puntus D, per quem transit radius; deinde per quantitatem CD multiplica quantitatem AB et productum divide per quantitatem AC et exibit EB longitudo plani quesita.

---

1 CD7 ED *η*; Postea...CD *om v*; quem *om β*, scilicet locum *supralin s*; transit *om f*; visibilis7 visualis *xzγδλ*, ad terminum plani *add K*; et sit7 per quem est *D*; punctus7 contactus *K*, pes *p*

Sed comodius fiet si accipiatur virga CD tanta quod radius transeat per terminos eius. Nota enim est facile punctum D esset terminus eius notatus *mg a*

2 linea *om dn*; virge *om LTWcemryz*; CD7 ED *η*; per...CD *om BSUθ*; punctus *om E*; D7 C *n*, *om Eμ*; radius *om o*, visualis *add U*, visibilis *add y*; et...radius7 D *α*; visibilis...radius *om Vw*

3 CD7 ED *η*, 12 *supralin q*; quantitatem^{2} *om BOXmrα*; AB7 32 *supralin q*; productum7 384 *supralin q*; divide7 AB *add T*; per *om Aε*

et expedit virgam CD esse nota quantitas alias difficilis esset calculatio *mg V*; Hoc intellige accipiendo D pro loco seu puncto illo virge constituere cum alia virga erecta angulum rectum. Hoc est ductum per quantitatem virge equidistantis a plano incipiendo a puncto per quem radius visibilis transit qui punctus exempli gratia vocatur D usque ad principium ipsius virge versus C *mg u*

4 quantitatem *om εζ*; AB...quantitatem *om Rz*; AC7 AB *P*, ABC *T*, AE *η*; et...AC *om w*; EB7 AB *B*, tibi *v*, *om DEFJSTUadeilmrstzθλμ*; plani *om q*; quesita7 ex eodem *add J*

quesita7 dummodo addatur altitudo virge AB vel distantia unius virge ad aliam *add n*; AC scilicet per distantiam utrimque AB ad terminum contactus alterius linee scilicet CD *mg P*

De eodem per speculum

68. Idem fit per speculum, ut intelligatur superior figura iacens in plano, sicut prius intelligatur erecta, et linea que ibi significabat altitudinem, modo significabit plani longitudinem, et reliqua que prius significavit planum, sit linea perpendiculariter

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1 De mensuratione altitudinum (altitudinis Tcel) per speculum DELT bceil, Secundarum (Item aliter h, Tertius as) de eodem per speculum Nahs, De mensuratione plani (curialiter x) per speculum kxδ, Idem per speculum t, De mensuratione plani in longum per speculum tantum β, Item aliter. De eodem subtiliori modo γ; eodem7 sine quadrante add CGMQRWjquικ, plano add K; speculum7 Capitulum add ι; tit om rell

2 Idem7 Deinde Nε, De eodem wδ, Item idem γ; fit7 scietur I, sit x, om inδλ; Idem...ut om L; intelligatur7 signatur pars θ; superior om I; figura7 virga v, signa θ, scilicet ABE supralin a

3 iacens7 ubi add v; plano7 AB add DEIJTcdeimrzγζθ, supralin kls, AN add y, totali supralin a; sicut7 ut ITceimrvzγζθ; prius7 superius q, et iacens (CB EITceimorvxyzαγζθικ) add ABCDEGHIKLNOPRSTVWYbcefghil moprvxyzαβγεζθικλ, et add F; intelligatur7 intelligebatur a, om θ, virga CB add μ; erecta7 virga EB erectam in F, om vαβ, CB supralin Dkl, CD supralin J; linea7 scilicet AB supralin a; ibi7 tibi y, sit θ

erecta7 Et linea scilicet prius iacens EB intelligatur scilicet nunc erecta add s; Scilicet similiter in capitulo Item aliter satis curialiter et cetera mg u

4 significabat7 signat U, signabit inqrwyβγθλ, figurabat mζ; altitudinem om t, AB add DEIcdeiyθ, supralin Jklmrs, scilicet AB supralin a; modo7 nunc Inλ, quo L, om eθ; significabit7 signabit RUnpβγθλ, signat iwδζ, figuratur m; plani om Iceiyθ; longitudinem7 longum U, altitudinem y, latitudinem ε, AB add Iceiyγζθ, supralin Dklmrs; modo...longitudinem7 AB T; et7 in w

Ego Johannes de Calomonte. Parva exempla habent hanc litteram. Et linea iacens intelligatur erecta tamen intellige eam utilem esse (scribal signature) mg s

5 reliqua7 scilicet BE supralin a; que om P; significavit7 signavit Uaiprwβδγ, figuravit mζ, signat θ; longitudinem...significavit om O; planum7 CB add EITceyγθ, supralin DJkls; linea om ι, CB add EITceyγθ, supralin D, perpendicularis vel add N; perpendiculariter7 distans add Y, CB supralin k, EB supralin l

instans longitudini in plano in quo debet poni speculum erectum super unum latus eius, et tu stabis inter speculum et terminum plani mensurandi.

De mensuratione plani in latum et longum

69. Si autem vis mensurare planum in longum et latum, tunc

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1 instans7 stans m ζ; longitudini7 scilicet AB supralin a; in^{2}7 a n; poni om e; speculum7 C add ITceizγθ, supralin Dl, E supralin s, scilicet in linea perpendiculari BE supralin a; erectum7 in plano oxν; in...erectum om B

Si enim iacetur non posset in eo judicari? longitudo plani id est AB mg a

2 latus7 B add EITceiyϒ, supralin DJkls, scilicet BC scilicet speculi supralin a; eius om Xd; tu om NWo, E add Eciϒ, supralin DJkls, C add Ty; tu stabis7 tunc stabit θ; speculum7 planum U; super...speculum om v; terminum om b

3 mensurandi7 operabis ut prius add V, et cetera add d, et sic de aliis add ε

mensurandi7 et nota quod speculum debet esse parvum et semper debes perspicere terminum altitudinis vel longitudinis in medio speculi add n; Donec videas per speculum finem seu terminum plani mensurandi et cetera mg u

4 Secundarum. De mensuratione plani in longum N, De mensuratione per longum et latum T, Quartus: De area circuli a, De mensuratione plani in longitudinem et in latitudinem e, Item aliter h, De mensuratione plani rotundi mr ζ, Sequitur de mensuratione per steriometriam t, De planis diversis γ, De mensura plani in longum et latum γ'ι; mensuratione7 mensurationibus u; et7 in add il; tit om rell

5 autem om Lwδ; vis om X; mensurare7 scire θ; planum om B; in om BO; et7 aut λ, om Fμ, in add Icdk; latum om Fμ, tunc om d

Secunda pars mensurationis plani in qua docetur mensurare in longum et latum mg Dl; que Si circulare mg l planum aut erit circulare, aut angulare. Si circulare, medietas dyametri ducatur in medietatem circumferentie, et productum dabit aream tocius circumferentie circuli.

70. Quantitas vero circumferentie habetur sic: triplicetur

---

1 planum7 artem plani U, om z; in...planum om X; aut^1 om OQZajuη; erit om δ; aut^{2}7 vel MQZjquη, erit add Lmn; Si7 sit add c, autem add v; Si circulare7 tunc cei, tunc add ILSTUVcmryzγζθ; medietas7 medietatis n, AB add EILTceiyγθ, supralin DJkl

Si angulare, totam distantiam in medietatem linee perpendicularis duc et habebis aream, idem sic multiplica illud latus super quod cadit perpendicularis in medietatem perpendicularis et productum dabit aream mg g

2 dyametri7 plani Zj, om η, AB add z; medietatem7 BCD add DILciyγθ, supralin Dl, CD add J, BC add T, 22 supralin q; circumferentie7 circularem yα, om BEadegilst, tocius (BCD ILTciγθ) add IKLTcimrzβδε ζθ; productum7 152 supralin q; dabit7 habet J, stabit θ, om de, tibi add B

ducatur7 id est multiplicatur add n

3 aream om d; tocius om Bg; circumferentie om BDEFIJKLSTUVabcdefgimnrz βγζθλμ; circuli om Yh

circuli7 Vel aliter multiplicetur diameter in se ipsum et (om g) hanc summam iterum multiplica per 11 et productum divide per 14 et numerus quotiens denotabit aream add n, mg g; illegible note mg K

4 vero om NRnελ, tocius add h; circumferentie om T, circuli add η; circuli...circumferentie om x; triplicetur7 tripletur NPQRSTUVWXY bdefghjkmopqruwxzαβγδεζηθκ

Alferabius dicit qui dicit tertium constare ex diametro est sumpta et .10. 70^{as} dat ei plus quam debet habere in veritate qui vero debet ipsum continere dyametrum tertium et in super .10. 71^{as} dicat minus quam debeat habere et id dicit Archimenides mg (para. 68 D, para. 76 1) Dl; Dicitur Archimenides et Alferabius qui dat circumferentie diametrum triplatam et eius .10. 70^{as}. dat plus quam debet habere et quam eandem dat circumferentialem. Triplatam et eius .10. 71^{as}. dat minus quam debet habere ergo eius quantitas, ergo eius proportionalitas in .10. septuagesimas et .10. septuagesimas primas constitit (?) (?) mg (para. 67) K diameter et addatur ei septima pars, et productum dabit quantitatem circumferentie.

De triangulo equilateri

71. Si autem superficies fuerit triangula, tunc si fuerit equilatera, mensuretur sic: dividatur unum latus trianguli in duas partes equales, et a puncto divisionis ad angulum oppositum

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1 diameter] 14 supralin q; ei om Wbv, postea add n; septima] quarta α, alia μ, om Wv, diameter add EMIθμ; pars] diametri add DFKLQTZ ceijkmnqruyzβγζη, scilicet diametri supralin J; productum] tibi add J, 144 supralin q; quantitatem] partem T, tocius add d

que quomodo habetur circumferentia per diametrum mg l

2 circumferentie] Si autem e converso volueris scire scilicet per circumferentiam diametrum subtrahe 22^{m} partem circumferentie ab ipsa circumferentia et quod remanet divide per 3 et numerus dabit tociens tibi diametrum. Vel sic multiplica in se ipsum circulum et quod exierit divide per 10 et numero exeunte provenientis quere radicem que erit circuli diameter. Vel aliter multiplica circulum in 30,009 et divide quod colligitur per 62,832 et quod tibi provenit ex hac divisione est diameter circuli add n; hand pointing to add with label error mg n

3 Quintus: De area trianguli equilateri a, De superficie triangula b, De equilatera planicie trianguli mr, De equilatera superficie plani ζ, tit om rell

quod hoc dicitur de triangulo equilatero et ysangulo patet ex 4^{o} primi Euclidis mg a, quomodo superficies triangula equilatera mg l

4 superficies] figura U, circumferentia d, superiores μ; triangula] 3 Rκ; tunc om Bδ

5 latus] AB add EIKTceiyzγθ, supralin Dl, CB add β; trianguli] 3 R, om I; in om o; duas] alia J, tres Z

6 partes om Tr; equales] vel in duo equalia add γ; duas...equales] duo equalia ILceimryzζθ; a om Se; puncto] D supralin Dkl; divisionis] usque add Fμ, D add z; ad] in ε; angulum] C add EIizγθ, supralin Dkl, trianguli add m

protrahatur una linea recta, tunc linea sic ducta ducatur in unam partem lateris divisi, et habebitur quantitas trianguli.

De triangulo duorum equalium laterum

72. Si autem triangulus habeat tantum duo (60v) latera equalia et tertium inequale, dividatur illud in duo equalia, et a puncto

---

1 protrahatur7 ducatur B, trahatur Gp; una7 illa μ; linea^{1}7 CD add EIKLTceiyzγθ, supralin Dkl, AD add β; recta om μ; tunc7 cum X, modo β, illa add DEIJKNSVcdefiklmnortwxyzβγδζθλμν, supralin g; linea^{2} om dλ, CD add EIceiyzγθ, supralin Dkl, recta supralin g; sic om Iceimryzγζθ, directa vel add JSVt;' ducta7 dividatur C, producta F, protracta s, om Iceimrvyzγζθ; ducatur om p; unam7 illam K, om Wδ

2 partem7 medietatem w, DB add EIKLTceiyzγθ, supralin Kl, DC add β; unam...lateris7 medietatem k; quantitas7 circuli et add L, dyametri add δ; trianguli7 3 R

trianguli7 Vel aliter divide unum latus in do media per lineam exeuntem ab angulo sibi opposito ad sui medium. Deinde ducatur unum latus trianguli in medietatem linee dividentis triangulum et productum dabit aream. Et nota quod latus trianguli equilateris est longius linea dividente ipsum triangulum in septima parte, unde si latus fuerit 7^{m} pedum linea dividens erit 6 pedum add n; Ut si linea recta ducta esset 3 pedum et medietas lateris divisi duorum area trianguli contineret secundum equivalentiam 6 pedes mg a

3 De mensuratione isocheles superficie F, Sectus: De area ysochelis a, as above mrζ, Idem quando triangulus habet 2 latera tantum equalis t, tit om rell

que sit duorum laterum equalium mg l

4 triangulus7 3 Rθ, om uz; habeat7 sit ILceimryζθ, fuerit z; tantum om ILceimnryzβζθμ; duo7 duorum ryzθ; latera7 laterum ryzθ, AC et BC add ELTceiyγθ, supralin DJ, ACB add z; equalia7 equalium ryzθ; et7 tunc Tceimr

5 tertium7 unum illud latus J, iterum oν, tunc unum z, om mrζ, AB add ETceiy, supralin DJLkl, 14 supralin q; dividatur7 latus inequale add g; illud7 idem h, om DEJKNSTUVbcdefilmnwδ, inequale add Faqμ, latus tertium inequale add st; duo7 duas partes UV, 3 w; equalia om U, in D add LTceiγ, 7 supralin q; et...equalia om Y; puncto7 D add ELTceiyzγ, supralin Dkl, A add θ

inequale7 (tunc nλ) illud latus tertium inequali add NSUVfknwδλ divisionis protrahatur linea ad angulum oppositum, et una medietas linee divise ducatur in lineam protractam ab angulo ad punctum divisionis, et productum dabit aream.

De scaleno superficie

73. Si autem fuerit trium laterum inequalium, tunc ab angulo

---

1 divisionis] de mensuratione superficiei ubi add N, medie supralin K; protrahatur] trahatur aμ, ducatur d, una add bч; linea] AB add EL, recta add b, supralin K; ad] in e; angulum] C add ELTceiyzγθ, supralin Dl, A supralin K; oppositum] oppositi isochelum N; medietas] DB add ELTceiyzγθ, supralin Dl, A supralin J, BD vel CD supralin K, AB supralin k

2 linee] AB add Tceiyzγθ, sit add UV, BC supralin K; divise om y; ducatur] vocatur d, multiplicetur n; lineam] DC add z, supralin Dkl; protractam] protectam a, productam θ, om Ln, 24 supralin q; ab] ad y; angulo] angulum y, C add ELTciyzγθ, supralin DJkl, A supralin K; ad] a β; punctum] puncto β, D add ETceiyγθ, supralin DKkl, E add L, productum add n

3 et] Deinde L; productum] punctum P, om L, D add z, 168 supralin q; aream] eius add H

aream] Vel aliter ducas totam basim divisam in medietate linee perpendiculariter ducte et habebis idem add n; Hoc est quantitatem tocius aree mg u

4 Secundarum. De scaleno superficie N, Septimus: De area quadrati a, De ortogonia mr ζ, De scaleno superficie. De mensuratione scalenonis superficie s, Quando 2 inequalis t, tit om rell

Intellige (Intelligas t) idem de triangulo orthogonio si ducas latera rectum angulum continentia in se medietas producti est (dabit t) (eius t) aream add mr ζ, mg t; Primo si trium laterum inequalium mg h; que si trium laterum inequalium mg l

5 autem om α, triangulus add S; fuerit ends treatise 87v s, aliter add u; ab] uno add BK, alio add α; angulo] C add LTceiyzγθ, supralin Dkl, A add β, supralin K, maiori supralin b

ad latus oppositum trahatur linea perpendicularis, et illud latus super quod cadit perpendicularis ducatur in illam perpendicularem et producti medietas dabit aream eius.

---

1 latus^{1}7 AB add ELTceyzγθ, supralin k, D supralin K, scilicet longius supralin b; trahatur7 contrahatur F, protrahatur Igwαλ, una add Tα; linea om p, CD add ELTceikyzαλ, supralin Dl, AD supralin K; perpendicularis7 12 supralin q; latus^{2} AB add DLTceiyzγθ, supralin kl, A supralin L, 14 supralin q

in figura ista poteris videre quod hoc dicit de triangulo quadrate? si ad 41 primi adcendis mg a

2 quod7 quo rλ, quem t; cadit7 dabit J, stat ELTceimryzβζθ, vel stat add γ, linea add EJLNSTUVcegintvwyβγδθλ; perpendicularis om j, CD add EJLTceiyzγθ, supralin Dkl; et...perpendicularis om fp; in7 ad Gpθ; illam7 lineam Kμ, (partem γ) CD add ELTceiyβγθ, CDA add K; perpendicularem7 partem UV, perpendicularis add N, CD add z, supralin DJkl; et...perpendicularem7 quod ducatur in latus ad quod ipsa ducebatur B; ducatur...perpendicularem om ν

producti medietas mg t

3 producti7 productum SVfnλ, 168 supralin q; medietas om JSUVfλ, 84 supralin q; aream7 duplum aree n; eius om EKUkγη, trianguli add MQZ jquη, a medietas eius add g

eius7 Si vis scire diametrum circuli scripti infra triangulum ortogonum tangens omnia latera ortogoni adde quantitatem linee ortogone quantitati basis et ex hac summa quantitatem linea trahe residuum erit quantitas circuli dicti unde si linea ortogona sit 6 pedum et basis 15 et podissim 11 erit ille diameter 4 pedum. Si vis scire aream trianguli ortogonii duple basim in ortogonum et medietas producti dabit aream. Vel duc medietatem basis in lineam ortogonam vel medietatem ortogone in basim et idem provenit add n, Vel aliter sic ducatur dimidium perpendicularis in totum basim et productum dabit aream totius triangulis quia idem provenit et ducta octonarii in medium duodenarii et erit ducta duodenarii in medium octonarii add λ; aliter et productum sive medietas et cetera mg N

De superficie quadrati

74. Si autem superficiem quadratam vis mensurare, duc unum latus in alterum, et productum dabit aream quadrati.

De superficie quadranguli invenienda

75. Quod si quadranguli vis superficiem metiri, ducatur minus latus in maius, et productum dabit aream eius.

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1 Octavus: De area quadrati a, De quadrato mrζ; quadrati7 Secundarum add N; tit om rell

Primo de superficie quadranguli et primo de quadrante. Secundo de mensuratione quadranguli mg h

2 superficiem7 super, quadrantum vel add μ; mensurare7 invenire Jbntλ, metiri LTceihmryzζθ, habere N; latus7 AB add LTceiyzγθ, supralin DJkl, 8 supralin q

3 alterum7 aliud AIPdmz, BC add ELTceiyzγθ, supralin DJkl, vel in seipsum add g, 8 supralin q; productum om kwδ, 64 supralin q; dabit7 habebis kwδ, tibi add Tceimrzζθ; quadrati7 eius P, om Iv, eius add L

4 De superficie quadranguli. Secundarum N, Nonus: De area quadranguli a, De quadrangulo mrζ; invenienda om k; tit om rell

5 Quod7 Sed y, om mrαζλ; si7 sive o; vis om Y; superficiem7 aream mrζ, om Uλ; metiri7 mensurare LTceikmrwyzδζθ, invenire (figura U) UVt, habere v; minus7 unum y, unius azθ, eius add B

6 latus7 AB add ELTceilyzγθ, supralin DJkl, 4 supralin q; in7 aliud add v; maius7 (latus T) BC add ELTceilyzγθ, supralin DJkl, 8 supralin q; et7 Deinde L; productum7 32 supralin q; aream7 quantitatem X; eius om nvα

Nota quod hec regula de area pentagoni est vera. Si latus in se ducendum ducatur dividatur per se alias fallaciae. Ut si dividatur per 3 tunc enim? debetur area esse 12 secundum hoc et tunc plus continet quadratum enim? quod est pars eius continet secundum hoc 9 et triangulus equilateris in que est reserva pars ipsius plus? habet quam 3 sicut ad superfiorem patet alias cathetus? ipsius trianguli non? habet? plus quam 2 secundam regulam hoc datam de area eius et erit sub (?) satis quod habet 3 quod falsum est etiam? non excedatur a latere nisi in 7 parte mg a; aream7 Si vis scire aream elimbarisse habentis duo latera opposita equidistantia et in equalia et alia duo latera equalia non tamen equidistantia quorum unum latus constituet duos angulos super equidistantiam rectos ad ortogonum dicitur. Adde unum latus equidistans alteri quod provenit ex additione multiplica per quantitatem ortogone et medietatis producti dabit aream. Vel sic multiplica medietatem eius quod provenit ex additione per ortogonum et habebis idem ut prius add n

De superficie pentagonia

76. Quod si superficiei pentagone vis aream habere, si sit equalium laterum, tunc unum latus in seipsum ducatur, et productum ternario multiplicetur; et a summa exeunte subtrahatur quantitas unius lateris semel, et medietas totius erit area.

---

1 Decimus: De area pentagonis a, De pentagone mr ζ; pentagonia] Secundarum add N; tit om rell

Primo de pentagono mg h; Hoc est abscicis angulos quinque mg u

2 Quod om n α; si^1] autem vis scire add α; superficiei pentagone om μ; habere] invenire y; si^2 om J, ergo add α; sit om J

3 equalium] inequalium c; tunc] aut U, om nq ε λ; latus] AB add ELTceiz γθ, supralin DJ1, 6 supralin q; seipsum] ipsum 1, AB supralin 1, 36 supralin q; in seipsum] mensure ipsum μ; productum] cum add I, in add μ

4 multiplicetur] 108 supralin q; et...multiplicetur om γ; et] tertium M; a om X μ; exeunte] excrescente JSUVktw δ, existente a, extense θ, om f; subtrahatur] extrahatur ν

inequalium angulorum mg g

5 semel] solum F, solis I, tamen μ, 102 supralin q; totius] residui add Qqu, 51 supralin q; area] srak bitl, sapranda? add μ

area] Explicit secunda pars de sensu quadrantis in geometrice add a, vel duc unum latus in medietatem orthogonis vel orthogonam in medietatem lateris et productum multiplica per 5 habebis aream add g; Sed si fuerit plurimum laterum quam quinque equalium vel fuerit quinque inequalium resolvendum est superficies in triangulos. Et tunc fac ut prius et ideo quelibet figura post resolvi in tot triangulos, quota est in ordine numeri figurarum ut pentagoni (?) que est tertia in ordine? que trianguli sunt primi mg (para. 80) I

Hic distinguit de profunditatibus

77. Dictum est de mensuranda rerum altitudine et planicie: nunc de puteorum profunditate et vasorum capacitate dicamus.

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1 Tertia pars mensurandi que steriometria dicendum AOdn, Sequitur de steriometria et primo de puteis mensurandis B, Tertio de steriometria et primo de mensura (om MQWu) putei (puteo MQWu) CHMQRWYu, De mensuris profundi et corporem DEbl, De puteorum profunditate mensurandi G, De puteis et vasis secundum K, Sequitur de mensuratione profundorum corporum LTei, De mensuratione fundi et puteorum N, De steriometria SZh, Incipit tertia per steriometria a, Sequitur de mensuratione profunditate rerum c, De steriometria et primo de planicie j, De vasorum profunditate mrζ, De steriometria: Et primo de puteo qη, De steriometria et primo de puteis et cetera x, De mensuratione vasorum et corporum β, De mensuratione profunditatis et spissitudinis puteitatis γ, Sequitur de mensuratione puteorum ε, Pars tertia huius tractatus que est de steriometria et primo de mensura puteorum ι, Capitulum tertium. De steriometria. Et primo de mensura putei κ, tit om rell

Capitulum. De steriometria (et primo?) de mensuratione corporum et profundítate (puteorum?) (seam) mg I; primo de putei profunditate mg dl

2 est om Tez, autem add γ; mensurande7 mensura η; rerum7 duarum scilicet add η; altitudine7 longitudine λ; planicie7 superficie dβ, planimetria y; nunc7 est add α

Primo de steriometria et primo de continentia dicamus. Secundo pro sequitur. Si igitur vis putei et primo de putei profunditate et eius capacitate. Primo de columpnis Si vero. Tertio de vasis. Si vero alicuius modii mg h

3 de om w, mensuranda add x; puteorum...et om λ; capacitate7 concavitate S, que est tertia pars add α; dicamus7 dicendum est FJSamrtzβγζθλμ, om DEKTbcdefily

De mensuratione puteorum et similium

78. Si igitur vis putei profunditatem metiri, ab uno latere putei respice cum quadrante terminum oppositi lateris in profundo putei, et notetur quantitas diametri latitudinis putei. Accipiatur igitur in hora considerationis numerus punctorum umbre in latere quadrantis, et multiplica quantitatem diametri latitudinis putei per 12, et divide per numerum punctorum umbre, et exibit profunditas putei.

---

1 Primus. Canon de putei profunditate a, tit om rell

De putei profunditate mg c

2 igitur om n; putei7 puteorum FSUVo, om X; metiri7 habere n, mensurari α; latere7 A add EKTceiyzβγθ, supralin DJk, FA supralin 1

Multiplica 5 et dimidii AC per ED 5 et divide per AD 2 et exibit CD profundum putei mg 1

3 putei om η; respice om β; terminum7 B add DEKLTceiyzβγθ, supralin Jkl; scilicet tenendo conum quadrantis in quo est clavus cui filum annectitur prope circulum ad γ; lateris7 alteris o; profundo7 fundo BDEFKLQSUVZbcdefklmnqrtwxyzβγδζημ

4 putei¹ om U, primo add CYtv; notetur7 locus sive add n; putei²7 DC add ETce, supralin D, AC add iyzβγθ, supralin Jkl, primo add Rk

id est quantitatem superficiei eius seu latitudinis superioris secundum planum ut docebatur supra. Hoc solum est verum de puteo equaliter lato per totum a profundo usque supra alias falsum est mg a

5 igitur7 prima v, om nε; in¹ om CDEFGHJKLMNPQTWYZcefhijklnopqtuvwxεζηκμ; umbre7 (scilicet t) recte add KMQjnqtuβ

6 quadrantis7 quadrati ESblβ; in...quadrantis om n; quantitatem7 lateris add v; diametri7 (scilicet e) AC add EKLTceyzβγθ, supralin Dkl, CAC add i, ABC supralin J; latitudinis7 lateris n; putei om κ; Accipiatur...putei om I

7 12 om γ; divide7 productum add MQZjnuη; et notetur...divide7 et notentur puncta umbre. Deinde quantitas dyametri latitudinis putei multiplicetur per 12, et productum dividatur B; per om ν; umbre7 recte add Zjnquη, supralin K; exibit7 quantitas putei (om O) et GOWXghpα; profunditas7 B add e, CB add LTceiγθ, supralin DJkl; putei7 end of treatise 9r n, om GWXghpα, AB add z

De putei capacitate

79. Si vero putei capacitatem vis habere, per aream putei, inventam ut supra dictum est, multiplicetur putei profunditas, et productum dat putei capacitatem.

De columpne grossicie

80. Si vero columpne grossiciem vis investigare, sumatur

---

1 *As above* (secundarum *N*, Secundus *a*) *Nakδ*, *tit om rell*

Si area sit 4 pedum profunditas 8, capacitas erit 32 pedum *mg a*; De putei capacitate *mg h*, in capitulo precedentis *mg u*

2 Si] Cum *a*; putei *om W*; habere] accipere *P*; per] et *μ*

aream] id est per quantitatem superficiei eius seu latitudinis superioris secundum planum ut dicebatur supra. Hoc solus est verus de puteo equaliter latere per totum a profundo usque supra alias falsus est *mg a*

3 ut *om d*; est] CB *supralin DJkl*; ut...est *om oyν*; profunditas] CB *add zγ*, CD *add β*

supra] de mensuratione plani circularis *add k*

4 dat] dabit *LMQTVZabceghjqyη*, tibi *add MQZjqη*; putei] profunditatem et *add V*; capacitatem] putei *add L*

Si igitur (*para. 78*)...capacitatem] Si vero putei profunditas est inventus ut supra dictum est multiplicetur putei profunditas per putei aream et productum dabit putei capacitatem *λ*; secundo de putei capacitate *mg l*

5 Tertius. De columpne grossitudine *a*, De mensuratione columpne *mrζ*, *tit om rell*

De columpne grossicie *mg cl*; Nota quod hec intra de columpne quadrilatera *mg g*, Primo de columpne grossitudine habenda *mg h*

6 vero *om λ*; columpne *om Wy*, equale grosse scilicet *supralin a*; grossiciem] grossitudinem *FJatλ*; vis] habere vel *add B*, metiri et *add E*; investigare] invenire *U*, habere *g*

quantitas latitudinis columpne et ducatur in se et habebis aream, per quam aream multiplicetur latus columpne, et productum dabit eius grossiciem.

De modii capacitate

81. Si vero alicuius modii rotundi vis habere capacitatem, sumatur diameter fundi modii et diameter superior, et equetur medietate excessus maioris addita minori.

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1 latitudinis7 lateris JMQUVZjktuwδλ; columpne om DEFJKSTUVbcefiklmrt wyzγδθλμ; ducatur7 producatur v; aream7 eius add FJNSUfkwδλμ, id est basim supralin a

et cum area sit quadrata alia sit altera parte longitudo ducatur minus latus in maius (?) rotunda invenietur (?) sicut supra dictum est de area circuli (seam) mg a

2 aream om GKPUWαβθ; per...aream om T; latus7 longitudo Iλ, lateri T, id est longitudo supralin a; grossiciem...columpne om p; et7 ne L; eius om jqλ

3 grossiciem7 grossitudinem FJaktwε, eius add dα

4 De mensuratione modii mr; Quartus before De a; modii7 inequalis add b; tit om rell

De circuli modii mensuratione mg c; de modii capacitate mg l; appelatio modii comprehendit puteum doleum vel quodcumque vas mg u; in principio capituli supponit puteum equalem habere rotunditatem in principio medio vel fine seu fundo. Hic vero supponit unum finis videlicet seu fundi partem maiorem esse principio vel e contrario mg u

5 vero7 autem SUVYαι; modii7 inequalis latitudinis add a; rotundi vis7 notandi d; habere7 perscrutari DEFJLSTUVabcdefilmyζθλ, scrutari Krβγ, invenire t, om μ; capacitatem7 vel rotunditatem add γ

6 fundi7 profundi J, CD add EKLTceiyzβγθ, CD supralin DJkl; modii7 rotundi add Rt; superior7 inferior v, AB add EKLTciyzβγθ, supralin k, BC add e, et dividatur superior add λ; equetur7 EF add Tceiyβγ, EC add θ, scilicet supralin g

7 medietate7 medio μ, EF supralin D, CD supralin K, DF supralin k, EC supralin l; minori7 CD add EKLTceiyβγ, supralin Dkl, quod triplicati supralin K equetur dato hoc modo medietate similiter et cetera quod sequitur mg u

82. Et inveniatur tunc area fundi, ut dictum est de circulo, et videatur quot digitorum sit, vel palmorum; per aream illam multiplicetur altitudo modii et productum dabit quantitatem capacitatis modii.

Quot parve mensure sint in modio

83. Quod si habueris aliquam mensuram parvam unius denarii vel duorum, tenens mensuram vini, quantitas modii multiplicetur in

---

1 tunc] cum F, om λ; fundi] CB add ELTeyzβγ, supralin Dkl, EB add c, supralin Ki, B add θ, sic adequati add λ; est om z; de] in UV, om N; ut...circulo om ν

est in precedenti capitulo mg u

2 et] ut K; videatur] tunc add γ; quot] quod Maefls; sit om α; palmorum] planarum W; illam om β, quod add μ

3 altitudo] AC add EKLTUceiβγθ, supralin Dkl; et] profundum add F; productum] punctum w; altitudo...productum om y; dabit] ostendet ζ, om Fmr; quantitatem om BUν

4 capacitatis] capacitatem BUν; et...modii om ACGHIOPRWXYghpαειк

5 Quotiens modius. Quintus: Contineat mensuram parvam a, De mensuratione vasorum h, De capacitate dolii m; in] uno add N; modio] Rubrica add δ; tit om rell

quot parve mensure sint in modio mg Dl; quot denariate intrabit in aliquo vase mg c; de mensuratione vasorum et primo de modii continentia mg h

6 Quod si] Si autem α; habueris] hoc vis U; aliquam] aliam P, unam UV, om LN; parvam] end of treatise 282r^b α; denarii] digiti UV

parvam] et velis scire quotiens illa parva contineatur in modio mg a

7 duorum] denariorum add Kkwβδ; mensuram om ι; unius...mensuram om v; modii om Goh; multiplicetur] dividatur Bav, vel (id est hx) dividatur add Khx; in] per BKsv, et Jm, om SUV

quantitas] et? tam? per canonem precedentem et multiplicata prius secundum mensuram? parvam id est si mensura parva fuerit unius palmi sumatur quantitas modii secundum palmos et secundum digitos si mensura parva fuerit sic distincta (seam) mg a numerum quantitatis mensure parve, et denominatio ostendet quotiens minus vas continetur in modio; et ita si parvum vas fuerit unius denarii, scietur quot denariate vini sunt in modio.

De dolii capacitate invenienda

84. Si autem alicuius dolii capacitatem vis habere, primo invenias aream fundi dolii per eius diametrum, ut dictum est prius:

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1 numerum *om* *U*; denominatio7 numerus quotiens *B*, denotans quotiens *P*; ostendet7 ascendet *y*, tibi *add* *g*; quotiens *om* *GOXgp*

2 vas^1 *om* *ce*; continetur7 tenetur *g*; in7 maiori vel (*om* *EKβ*) *add* *EKLT ceimryzβγζθ*; modio7 maiori *BP*, maiori add *MQZqη*; ita *om* *e*; parvum7 per unum *a*; vas^2 *om* *Liβζθ*

illegible note mg η

3 denarii7 vel duorum *add* *B*; quot7 quod *f*; denariate7 dyametrie *X*, *om* *θ*; vini7 scilicet ideo *supralin* *a*; sunt7 fuerit *I*, vel sint vel fuerit *L*; modio7 de dolii capacitate *add* *J*; et...modio *om* *SUV*

4 capacitate7 Sectus *add* *a*; invenienda *om* *Nabkmrζ*; *tit* *om* *rell*

de dolii capacitate *mg* *Dl*; regula *mg* *c*; Primo de dolii continentia et primo rotundi. Primo quadranguli *mg* *h*

5 autem *om* *kmrzζ*; alicuius7 alius (*sic*) modii vel *I*, *om* *d*; dolii *om* *X*; capacitatem7 vel quantitatem *add* *γ*; vis7 scire vel *add* *c*; habere7 invenire *SUV*

primo7 hec est verus de de dolio equilatere per totum alia regula fallaciae et plus addatur *supralin* *and* *mg* *a*

6 dolii7 dividatur per quantitatem modii *add* *j*; dictum7 predictum *cimy*; prius7 superius *hkwδ*, *om* *Ucimλ*; dictum...prius7 predictam est *Trzζ*; ut...prius *om* *oν*

vel eius dolii vel eius contenentie *mg* *g* postea sume longitudinem secundum vini capacitatem, et per illam longitudinem multiplicetur area, et denominatio dabit quantitatem dolii.

Quot modii sint in dolio

85. Quod si habueris modium et velis scire quotiens dolium contineat modium, sume eius quantitatem per predictam, et quantitas dolii dividatur per quantitatem modii; denominatio dabit quotiens modius continetur in dolio.

---

1 postea om θ; longitudinem] latitudinem δ, dolii add BDEJKLNSTbcfikmoqruwxyzβγδζηθλ, eiusdem (eius Fμ) dolii add FMaltμ; per...longitudinem om e; secundum] vel qy, om β; vini om Xq; capacitatem] continentiam DEFJKLSTUVadefiklmrtyzβγδζλ; per om iw

longitudinem] vacuitatis interioris scilicet? ubi vinum continetur et non a plurimi? alias errares supralin a

2 longitudinem] dolii add lt; area om Gp; denominatio] productum B, denotans quotiens P, capacitatis add β

4 Quotiens dolium contineat modium a, De capacitate modii mr, tit om rell

quot modii sint in dolio mg Dl

5 modium] dolium IUVWv; dolium om λ

6 modium] dolium λ; et...modium om DEFJKLTUVcdefilmrtyzβγζθμ; sume] quod add d; eius] utriusque B, ipsius y, om J

illegible note mg K; regula mg c

7 dividatur] multiplicetur DEFJLTUVbcdefgiklmrtwyzβγδζθμ; per predictam...quantitatem om p; modii] dolii ε; denominatio] et modii et numerus denotans quotiens B, denotans quotiens P, id est numerus quotiens supralin a; quotiens] quot N

aliter multiplicetur mg N; similiter in precedenti capitulo rubrica mg u

8 Quod...dolio om R

86. Quod si modius fuerit unius nummate vini, scietur quot denariate erunt in dolio.

De capacitate vasis quadrangularis

87. Si autem quadranguli vasis capacitatem vis habere, sumatur area fundi vasis secundum artem superius dictam, que area multiplicetur per eius altitudinem et productum dabit capacitatem.

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1 modius7 dolium LTceiθ, vel dolium add E; modius...modius om y; unius om ϒ; nummate7 denariate Xaλ, mensurate ε; vini om zλ

2 denariate om θ, vini add BFGmprsζμ; dolio7 modio ft; Quod...dolio om IMNQUVZjquη

regula mg c

3 Octavus: De capacitate vasis quadrantis a, De capacitate modii ζ, tit om rell

de capacitate vasis quadranguli mg Dl; de mensuratione vasis quadranguli mg c; Primo de mensura quadranguli mg h

4 autem om λ; quadranguli7 quadrati UV; capacitatem7 vel quantitatem add I

5 fundi7 profundi mrζ; artem om U; superius7 supra Trz, iam h, situs δ, om u, scilicet planimetria supralin a, datam seu add μ; dictam7 datam tv, predictam u

6 eius om ζ, longitudinem sive add kwδ; altitudinem7 latitudinem i; capacitatem7 60v A, 32v B, 60r H, 57r^{a} b, 28v l, 27v m, 46r^{b} ι, 304r^{b} κ, 158v μ, 110r^{b} ν, eius (et cetera Xθ) add (82v θ) GOUVWX ghkpwδθ, vasis quadrangularis add (125r η) MQZjquη, nichil plus add d, et hec sufficiant dicta add β, et cetera add 74r ζ

capacitatem7 Et ita si parvum sit unius denarii scitur quot denariate vini sunt in modio add y; Incipit tractatus quadrantis compositus magistro Robert Anglico in monte pessulano ad traductum (?) (?) (?) (?) astronomia mg ζ

Explicit quadrans

1 Explicit 56v^b F, 78r Q, 6v S, 156v h, 120v o, Explicit tractatus quadrantis veteris 46v^b G, 148 r p, 179v^b u, Explicit quadrans amen amen amen 53r I, Explicit quadrans. Altitudinis quantitatem per umbram Solis et virgam erectam habere. Non existente Sole invenire per erectam virgam speculo interposito quanta sit altitudo parallela. Datam profunditatem quanta sit invenire. Datam longitudinem quanta sit invenire 38r^b L, 17r^b T, 57v^b e, 39r^b i, Explicit quadrans vetus 71v M, Explicit tractatus quadrantis et per consequens alii tractatus de forma 15v^a N, Explicit tractatus quadrantis 80r^b R, 44r^b W, 66r^b Y, 129v r, 81r z, Explicit practica quadrantis novi et per consequens totius tractatus eiusdem 17v U, Explicit explicit explicit 57v^a V, Explicit quadrans magistri Roberti Anglici 53v f, Explicit quadrans. Ad habendum unam regulam de altitudine mensuranda ubi notandum quod si perpendiculum ceciderit super dyametrum quadrantis erit altitudo equalis longitudini addite stature si super umbram rectam erit si super versam minor erit major. Explicit quadrans tam novus quam antiquus conscriptus super quartas partes Jacobi a personali anno domini 1321^o apud Renen 172r g, Explicit tractatus quadrantis moderni 70r k, Explicit tractatus quadrantis. Ex scrip. Jo, cos? Die. vii. Aug. MDXII 53v q, Explicit quadrans magistri Roberti de Montepessulano 173r^a t, Explicit quadrans moderni 105r^a w, Altitudinis quantitatem per umbram Solis et virgam erectam habere. Non existente Sole invenire per erectam virgam speculo interposito quanta sit altitudo parallela. Datam profunditatem quanta sit invenire. Datam longitudinem quanta sit invenire. Explicit quadrans magistri Johannis Anglici in monte 282r x, Explicit tractatus quadrantis Ricardi 39r^b y, Explicit tractatus antiqui quadrantis 236r β, Explicit compositio quadrantis cum sua practica 94r γ, Explicit quadrans modernus 126r δ, Explicit quadrans pro mandato (?) 160r ε, Finis 113v^b λ; quadrans 72v C, 143r D, 8v E, 168v^a K, 38r^a L, 41v O, 179v P, 53r X, 67r^b Z, 15v c, 44r^b d, 55v j, 25r^b v; et...quadrans missing, folio cut 6r a

GEOMETRIE DUE SUNT PARTES PRINCIPALES

TEXT AND NOTES

Manuscript Sigla for *Geometrie due sunt partes principales*

A	Venice, Biblioteca Marciana, fondo antico, 332 (IX, 6), ff. 236v-239v, 13th c.
B	London, British Library, Royal 12 E XXV, ff. 152r-155r, 13th c.
C	Oxford, Bodleian Library, Ashmole 341, ff. 143v-144v, mid-13th c.
D	Oxford, Bodleian Library, Digby 174 (B.N.9), ff. 145r-145v, 12th c.
E	Oxford, Bodleian Library, Digby 147, ff. 35r-38r, 14th c.
F	Cambridge, University Library, Ii I 13, ff. 41r-42v, 14th c.
G	Vatican City, Bibliotheca Apostolica Vaticana, Ottoboniano latino 1430, ff. $38v^{a}$-$39v^{a}$, 14th-15th c.
H	Oxford Bodleian Library, Canon. Ital. 157 (20209), ff. 9r-16r, 14th c.
I	Paris, Bibliothèque Nationale, fonds latin, 7196, ff. $32v^{b}$-$35v^{a}$, 14th c.
J	Paris, Bibliothèque Nationale, fonds latin, 7377B, ff. 83r-89r, 15th c.
K	Cambridge, Trinity College, R.2.86, ff. 21r-25v, 15th c.
L	Cambridge, Fitzwilliam Museum, McClean 169, ff. 256v-259v, 15th c.
M	Heiligenkreuz, Zisterzienserstiftsbibliothek, 302, ff. 213r-217v, 15th c.
N	Vatican City, Bibliotheca Apostolica Vaticana, Regina Sueviae 1261, ff. 269v-292v, 15th c.

Geometrie due sunt partes principales

1. Geometri (*236v*) due sunt partes principales theorica et practica. Theorica est quando sola mentis speculatione quantitatem proportiones adinvicem intuemur. Practica est quando per aliquam notarum quantitatum notitiam quantitatis minus note sensitive

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1 Incipit (quedam *F*) practica geometrie *FHI*, Rubrica? Practica geometrie *N*, tit *om* *ABCDGKLMOP*

granum ordei secundum longum est radix mensurarum quorum quatuor faciunt digitum, quatuor digiti faciunt manum sive palmum ut comentum geometre in suo prologo libri 46 in 40 dicit quod palmus facit quatuor digitos et unciam 3 et uncia continet digitum et tertiam partem digiti *mg* *A*; Joannes Dee 1554 *mg* *J*; Practica geometrie (*diff*. *hand*) *mg* *J*

2 sunt7 species vel *add* *M*; principales *om* *K*; theorica7 scilicet *add* *BFGLP*

3 Theorica7 scilicet *add* *FL*; quando7 que *M*; speculatione *om* *C*; quantitatum7 quantitates et eorum (earum *K*) *GHK*

Practica est ante notitiam quam solum proportionalem que est notitia generalis per comparationem illa reducimus quantitatem in rationale notitiam quantitatem date que est notitia particularis et hoc est qualiter conservare?...(*continues*, *illegibly*, *another twenty lines*) *mg* *A*

4 adinvicem7 et eorum mensuras *M*; intuemur7 intuimur *C*, nitimur *F*, intuetur *M*; est *om* *F*

5 notarum *om* *F*; quantitatum7 quantitatem *F*; minus7 unius *F*; note *om* *C*; sensitive7 sentire *I*

id est sensibiliter et intelligibiliter *mg* *E* comparamus. Note quantitates appellantur quantitates usitate apud omnes ut palmus, pes, cubitus, ulna, passus pertica, stadium miliare, huius vero quantitatis investigatio mensuratio appellatur. Mensurationum alia artificialis alia inartificialis. Inartificialis est quando per unicam vel multiplicem appellationem note quantitatis ad ignotam notitia ignote quantitatis supponitur. Artificialis mensuratio est quando per considerationem in instrumentis et opus numerorum ad notitiam quantitatis ignote venimus.

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1 comparamus] operamus *H*, intuemur *I*, et *add* *F*; Note] autem *add* *H*; quantitates^{2} *om* *G*; usitate] usuate *E*, visitate *I*

2 omnes] nos *I*; palmus] palma *JL*; passus *om* *M*; pertica] perticha *K*, *om* *BF*; stadium] studium *C*, et *add* *K*

3 miliare] Et *add* *HK*; huius] cuius *IN*; vero] modo *H*, *om* *GK*; quantitatis] quantitatum *GH*; investigatio] apud omnes *add* *MN*

4 alis^{1}] est *add* *I*; inartificialis^{2} *om* *M*

5 est *om* *F*; unicam] unam *F*; vel] aut *M*, per *add* *BDFGIJKM*; appellationem] applicationem *BCFHIK*, *supralin* *A*

6 ignotam notitia] quantitatis notitiam *B*; ignote] note *B*, ignota *N*, *om* *L*; quantitatis *om* *L*; supponitur] et *add* *F*; Inartificialis... supponitur *misplaced, follows* venimus, *I. 8 I*

supponitur] ut ulne ad pannum *add* *D*, *mg* *E*

7 mensuratio *om* *AEKN*; quando *om* *M*; in] non? *F*, *om* *M*; et *om* *F*

8 venimus] pervenimus *H*

2. Artificialis mensurationis tres sunt species: altimetria, planimetria, steriometria vel cosmimetria. Altimetria est quando solam rei longitudinem querimus. Planimetria est quando longitudinem et latitudinem querimus. Steriometria sive cosmimetria est quando longitudinem et latitudinem et spissitudinem investigamus.

3. Primo dicendum est de altimetria sed premittende sunt quedam regule ad sequentia necessarie hee scilicet; si fuerint

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1 Artificialis] autem *add* *D*, vero est *add* *I*; mensurationis] mensuratis *K*; species] partes *B*, scilicet *add* *FLM*

2 planimetria] et *add* *F*; vel] sive *FGHIKM*; cosmimetria] comimetria *H*; est *om* *CG*

3 solam] solum *M*, *om* *F*; rei] re *C*, *om* *F*; longitudinem] altitudinem *H*, lungitudinem (*passim*) *I*, vel altitudinem *add* *F*; est *om* *CGN*

4 et latitudinem] cum latitudine *GHK*; querimus] investigamus *N*, *om* *BCDEGHIJL*; Planimetria...querimus *om* *F*; Steriometria] est *add* *AE*

Steriometria] a stereon grece (*om* *N*) quod est (dicitur *E*) corpus latine (*om* *N*) *add* *L*, *mg* *E*, *supralin* *N*

5 sive cosmimetria *om* *DGHIK*; est *om* *CH*; et^1 *om* *EGKLN*; spissitudinem] profunditatem *G*

6 investigamus] querimus *G*, perscrutamur *N*

7 Primo] ergo *add* *CGHK*; dicendum *om* *C*; est *om* *ABCEGIJL*; premittende] permittende *JK*

8 quedam] alique *M*; ad] quedam *add* *K*; sequentia] consequentiam *GH*; hee] que *F*, *om* *GHIK*; scilicet] sunt *EF*, *om* *GHIK*; fuerint] erunt *G*, fiunt *N*

prima regula (*beginning of numbering of next 8 rules*) *mg* *BKN*; regula *mg* *E* due quantitates note earum proportio erit nota. Dividatur maior quantitas per minorem et quod exit in divisione erit proportio maioris ad minus, id est, denominatio proportionis. Item si

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1 note om G, hoc modo add K; erit om AK; nota7 Et add F; Dividatur7 Dividitur FN, autem add AE, enim (primo D) add DLMN; maior om G

2 per7 in E; exit7 exierit J; in divisione om GHK

minorem7 ut 12 per 4, hoc est detrahatur minor a maiori, quotiens poterit fieri ut numerus quotiens. Et numerus qui (ut numerus quotiens mg) exibit in detractione sive divisione, illa erit proportio id est denominatio proportionis quam se habet maior quantitas ad minorem. Hoc est ab illo numero denominabitur proportio maioris ad minorem. Verbi gratia secundi numeri scilicet 8 et 2. Dividatur 8 per 2 et per predictum modum et patet quod tantum quatuor post detrahi ab illo unde secundum hoc ponatur numerus etiam? qui exit in divisione illa, et a quantitate denominatur proportio octonarii ad binarium. Vel si tantum velimus scire proportionum binarii ad 8 dividi tunc debet minor per maiorem. Et dividere minorem per maiorem est intelligere minimam summam a maiore numero et denominationem a maiore. Verbe gratia binarius et 3 duo et octonarius. Quas duas octavus si viginas? habebis minutam 8 sed omnis quarta ad suum totum se habet sicut unitas ad quatuarum scilicet aliquam ad 8 se habet subdupla quare. Et 2 cum sint due octone 8 et ita quarta pars ad octonarium se habet ad subquadrapla. Et distinguetur proportio 8 ad duo. Et ab ea que est 2 ad octonarium in hoc quod habet propositio supponitur ibi super est de quibuscumque numeris habentibus proportionum inter se. Ut patet in 2 et 3 (et ad 3 supralin) in sextupla proportione se habet et 2 ad 3 in sexquialter? Et est sexquialter? proportio quando unus numerus semel continet alterius et insuper medietatem 2 scilicet et 1 et similiter de aliis numeris secundum proportionem dicendum est. Quare patet istum quod prius dicebatur scilicet quod enim fuerint due quantitates et cetera add D

3 maioris7 magis C, quantitatis add BCDIK, erit nota add G; minus7 minorem M; ad...est7 et minus vel C; et...proportionis om D; Dividatur...proportionis om I; Item om GHK

secunda regula mg BKN; ut dupla mg E

proportio aliquarum quantitatum fuerit nota et una illarum est nota, reliqua erit nota. Si enim maior est nota, dividatur maior per proportionem, et exit minor. Si minor est nota, multiplicetur minor per proportionem et preveniet maior. Item si aliqua quantitas est nota et una eius pars est nota, reliqua pars erit nota. Subtrahatur enim pars nota relinquitur residuum notum. Item si due quantitates fuerint note compositum ex eis erit notum,

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1 aliquarum7 duarum add GHIK; fuerit7 erit L; nota om BF; illarum om ABCEFJLMN; est7 fuerit D, sit L

2 nota^{1}7 et add DEL; nota...nota^{1}7 et una nota BD; reliqua7 illarum add DK; erit7 est EH; enim om GHK; est7 sit FL, om ABCEJM; maior om BGI

3 per om FM; proportionem7 portionem A, om F, id est per denominationem proportionis add ADELN; et om L; exit7 exibit CDGHK; minor^{1}7 id est numerus quotiens add D; Si7 Sed G; est7 sit F, om BCIJK

tertia regula mg BKN; multiplicetur7 ut 8 per 2 supralin D

4 minor7 decem (stet) M, om CG, est add AKM; per proportionem om F; proveniet7 provenit GHM, numerus quotiens supralin E; Si enim... maior om I; Item om GHIKM; si7 sit add F; aliqua7 alia CF

5 nota et una7 alia F; est^{2}7 sit F; nota^{2}7 et add D; pars^2 om FGHK, eius add D

quarta regula mg BKN

6 enim om GH; pars7 que est add BI; Subtrahatur enim pars7 Subtracta parte GHK; nota7 et add ACDE; relinquitur7 relinquatur A, (et N) relinquetur EKLN; relinquitur...notum7 et residuum erit notum F; reliqua...notum om I; Item om GHIK

notum7 Item si (p. 124, l. 1)...proportionali (p. 127, l. 7) added here but repeated in usual place in text F

7 fuerint7 sint BCJ; note7 conjunctum sive add ADELN; compositum7 conjunctum I; eis7 hiis DFIN

.3. proportio mg E

addatur enim una alii. Item si fuerit proportio alicuius quantitatis ad suam partem nota et fuerit excessus super illam partem notus erit illa pars nota et tota quantitas nota. Sumatur enim illa proportio et detur aliquis numerus notus; postea multiplicetur proportio per illum numerum et de producto auferatur idem numerus et per residuum dividatur id quod provenit ex ductu dicti numeri in partem quantitatis date notam et exit pars quantitatis ignota quam queris.

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1 enim *om GHK*; alii] alys *(stet) M*; addatur...alii *om FI*; Item *om GHIK*; fuerit] maiori *add D*, aliqua *add I*; quantitatis *om F*, note *add N*

quinta regula *mg BN*; 3 proportio *mg E*; 8 regula *mg K*

2 nota] notam *F*; et *om G*; excessus] totius *add GHKM*; super] supra *BDFHJ*

3 nota^{2} *om BFI*, Si *add G*; et...nota^{2} *om L*; enim *om GHK*; proportio] portio *K*

4 detur] dividetur *M*; multiplicetur] illa *add F*

5 numerum] notum *supralin N*; et de producto *repeated B*

6 id] illud *BFGIM*; dicti *om BCJ*, ducti *M*; partem] parte *G*; in partem *repeated F*

7 date] datam *F*, datam *M*; exit] exibit *AEGHLMN*; ignota] nota *B*, ignote *F*; quam] quem *B*, *om H*; queris *om H*, et cetera et cetera *add M*; et tota...queris *om I*; Sumatur...queris *om K*; Item *(line 1)*... queris *misplaced after* proportionalia, *(p. 127, l. 7) but collated here F*

date] id est in excessum super partem notum *supralin N*; queris] Ad secundum nota quod si suerit oculis in eodem plano super quem erigitur altitudo sive *add H*; sexta regula *mg BN*

Item si quadratum est notum et radix erit nota extrahatur enim radix si habeat radicem veram. (237r) Sin autem iuxta opus minutiarum potes procedere extrahendo radicem quantumlibet ut non sit error sensibilis.

4. Item si fuerint tres quantitates continue proportionales et due illarum fuerint note tertia erit nota. Si enim primum et secundum fuerint nota ducatur secundum in se et productum dividatur per primum

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1 Item om IK; quadratum] quadrantum K; est] sit F, fuerit I; et] eius add ADEILN; erit] est I; Item (p. 123, l. 1)...nota misplaced after ignota (p. 126, l. 3), but collated here GH; enim] ibi C, om ABGHI

veram (catchword) mg A; two short, illegible notes D; 5 regula mg K

2 veram] unam FK; Sin] Secundum DI, Si K; autem] aliam FG; minutiarum] minutarum M; potes] potest FN

Dicit (glo- supralin) veram propter ea que non sunt numeri quadrati ut 10 et 12 (-sa supralin) add N

3 radicem om F; quantumlibet] quantumque F; sensibilis] manifestus add H; extrahatur...sensibilis om I

septima regula mg BN

4 Item om GHIK; fuerint] sint C; quantitates] note add I; proportionales] proportionatus M

5 illarum om F; tertia] illarum add I; nota om BFKM; enim om FGHKM; primum] principium C; et] vel E

practica geometria mg L

6 fuerint] fuerit ACEGJKMN; nota] note F, notum ACEHJKLMN; secundum] secunda F, tertium C; et om ADEFGHKLM; productum] producta F; dividatur om M; per] in L; primum] primam F

et exibit tertium. Et si primum esset ignotam et tertium erit notum, idem productum dividatur per tertium et exiet primum. Si vero primum et tertium fuerint nota et secundum ignotum ducatur primum in tertium et producti radix quadrata erit secundum. Item si fuerint quatuor quantitates proportionales sive continue sive discontinue et fuerint tres illarum note, quarta semper erit nota. Si enim prima vel quarta fuerit ignota ducatur secundum in tertium et productum

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1 tertium^{1}7 tertia *F*; primum7 prima *F*; esset7 sit *FGHK*, est *M*; ignotam7 ignotum *ADEHN*, ignota *F*; et^{3} *om* *GHK*; tertium^{2}7 tertia *F*, vero *add* *HK*; dividatur...tertium^{2} *om* *BFJM*; erit *om* *CJ*; notum7 nota *F*, *om* *C*

2 productum7 ignotum *E*, producta *F*; dividatur7 dividetur *JM*; per7 primum *add* *C*; tertium7 tertia *F*; exiet7 exibit *FGHK*; et *om* *J*; primum^{1}7 tertium *C*, prima *F*; vero7 enim *M*; primum^{2}7 prima *F*

tertium7 scilicet secundi in se *supralin* *N*

3 tertium^{1}7 tertia *F*; secundum7 secunda *F*; ignotum7 non *F*; primum7 prima *F*; tertium^{2}7 tertiam *F*

4 producti7 producta *J*; quadrata7 quarta *F*; erit7 exit *E*; Si enim primum...secundum *om* *I*; Item *om* *GHIK*; quatuor *om* *M*

7 regula *mg* *K*

5 proportionales7 continue *add* *GK*; sive^{1} *om* *L*; continue7 sit *add* *D*; sive^{1} ...discontinue7 continue *GHK*, *om* *CEFIJM*, *supplied in mg* *B*; fuerint7 sint *C*

continue vel non continue *supralin* *A*; octava regula *mg* *BKN*

6 tres *om* *I*; illarum *om* *FGHK*; note7 et *add* *JN*; semper *om* *FGHIK*; enim *om* *GHK*; prima7 primum *D*; vel7 per *G*

7 fuerit7 fuerint *M*; secundum7 secunda *F*; tertium7 tertia *F*; secundum in tertium7 primum in quartum *D*; et *om* *FHK*

dividatur per notam et exibit ignota. Si vero secunda vel tertia fuerit ignota ducatur primum in quartum et productum dividatur per notam et exibit ignota.

5. Adhoc nota quod si fuerit oculus in eodem plano super quod erigitur magnitudo perpendiculariter formatur triangulus in aspectu cuius una linea est radius emissus ab ocule ad inferiorem magnitudinis

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1 et *om* *CE*; ignota] ignotum *D*, ignotam *F*; vero] enim *BDIM*, modo *E*

2 fuerit] fuerint *M*; primum] primam *F*; quartum] quartam *F*; et *om* *FHK*

3 notam] notum *GHK*; ignota] ignotum *FHKM*; Si...ignota *repeated* (*except* enim] vero, et *om*, ignota] ignotum) *J*, *om* *D*; Si enim prima...ignota *om* *I*

ignota] vero secunda vel tertia fuerit ignota ducatur primum in quartum productum dividatur per notum et exhibit ignotum *add* *C*, Item potest aliter accipi regula. Si dividatur secundum per primum et numerus quotiens multiplicetur per tertium resultabit quartum. Et hac regula utitur in secundo modo operandi in prima practica. *Adhoc* *nota* hic (glo- *supralin*) addit predictis 8 regulis quasdam significationes verborum in quibusdam suppositionibus et unam regulam (-sa *supralin*) *add* *N*

4 Adhoc] Adhuc *AEMN*; quod^1 *om* *M*; Adhoc...quod^1] Item *I*; oculus] circulus *EN*, vel circulus *add* *D*; eodem *om* *I*; super quod] semper et *BFM*

5 erigitur] erigatur *IMN*, altitudo sive *add* *GHK*; perpendiculariter] perpendiculatione *I*; formatur] formam *F*; aspectu] aspecta *M*

6 cuius] eius *I*; magnitudinis] videntis *I*; inferiorem magnitudinis *om* *L*

basis *mg* *N*

terminum et dicitur basis. Alia est altitudo magnitudinis et dicitur cathetus. Tertia est radius emissus ab ocule ad superiorem magnitudinis terminum et dicitur ypothenusa. Item nota quod si aliqua linea secet duo latera trianguli et equidistet tertio fuerint duo trianguli similes totalis et partialis et erunt latera continentia et respicientia equales angulos in similibus triangulis proportionalia.

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1 altitudo] latitudo F

2 radius] est add C; radius...oculo om F; ad] a M

et proveniet .160. illud dividatur per 4 et exeunt 40 mg D; cathetus mg N

3 et...magnitudinis om H; cathetus...dicitur om G; basis...dicitur om IJK; ypothenusa] compothema? F, compotenusa H; nota quod om IM

dificit mg H; ypothenusa mg N

4 aliqua] alia CFGL; secet] inter te per F; duo om ABEJLMN; trianguli] triangulatia K; equidistet] equidistat GH, equedistanter I, equedistet J, distet eque M; tertio] basi I; fuerint] fiunt ACEJN, fuerit HM, erunt I, fient K

5 duo om F; trianguli] anguli J; fuerint...trianguli om G; similes] scilicet add I; totalis] totales F, secundum add H, scilicet supralin N; et^1] si et add K; partialis] proportionalis C; erunt] duo add K; continentia] contingentia H

6 in] et F, om H; triangulis] angulis I

per 4 6^m (Euclid) supralin N; angulos] probatio huius? fiat per 4 propositionem sexti Euclidis; est enim parvus triangulus similis magno et per ultimum notabile huius et per 8 regulam mg N

7 proportionalia] proportionalibus F, Item...nota (p. 123, ll. 1-3) repeated

6. Cum volueris metiri altitudinem perpendiculariter erectam super planum aliquod et possibile est ut oculus sit in eodem plano erigatur virga note quantitatis perpendiculariter super illud planum et moveatur oculus huc illuc quousque oculus supra summitatem virge videat summitatem turris. Deinde metire distantiam inter oculum et inferiorem terminum altitudinis et multiplica illam per quantitatem virge. Productum divide per quantitatem distantie inter oculum et virgam et exibit quantitas altitudinis. Verbi gratia ponatur

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1 Cum] igitur add FK, ergo add GHIM; altitudinem] rem B, om CJ, AB add M; erectam om C

2 planum] AC add M; aliquod om M; et possibilie] necesse F; ut] quod M; oculus] C add M; sit] est M; plano] et add M; aliquod...plano] per idem planum I

illegible note mg N

3 virga] virgula I, dicta est add M; note] no[c]te I; perpendiculariter om B; super] supra AE; illud] idem DGHK; planum] AC add M

4 moveatur] C add M; huc] et add F, atque add H; oculus^2 om BGHK; supra] per FGHIKM; virge] ED add M

5 videat] percipiat F, videas H; turris] altitudinis I, sive ciuscumque altitudinis add H; distantiam] que est add H

6 terminum] partem F; altitudinis] AB add M; illam] eam DI; per om KM

7 virge] (DE M) et add BHM; per om F; quantitatem] quantitatis F, om B; distantie] distantiam B; oculum] C add M

8 virgam] DE add M; exibit] exit J; altitudinis] alterius J, AB add M; Verbi gratia om B; ponatur] quod add M

distantia inter oculum et inferiorem terminum altitudinis 20 pedum, longitudo virge sit 8 pedum, et distantia inter oculum et virgam 4 pedum. Multiplicetur ergo 20 per 8 et proveniet 160. Illud dividatur per 4 et exeunt 40. Et hec est quantitas altitudinis. Vel aliter dividatur distantia inter oculum et inferiorem altitudinis terminum per distantiam inter oculum et virgam. Et quod exit in

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1 oculum] C add M; inferiorem om M; terminum] partem D; altitudinis] scilicet add D, AB sit longitudo add M; 20] xx A; pedum] pedem DFK

2 longitudo] vero add ADJLMN; sit om BFIL; pedum om I; et^1 om ABCEGHKLM; sit...et^1] scilicet I; distantia] autem add D; oculum] C add M; et inferiorem...oculum om F; virgam] sit add H, ED add M

3 ergo] igitur HL, om FGIK; 20] xx A, 40 I, partes add M; 8] 4 I; proveniet] provenient BDGHKL, provenit C, proveniunt FM, proveniens I; 160] Et add M; Illud] id C, ergo productum add I

4 exeunt] exibunt CJK, erit F, exibit G; 40] 20 M; et...40 om H; hec] hoc M; altitudinis] metiende add ADELN

5 oculum] C add M; et om B

6 terminum] partem F, om AEI, AB add M; oculum] C add M; virgam] DE add M; Et^2 om ACEGHJK, illud add M; exit] erit C

divisione multiplicetur per quantitatem virge et proveniet quantitas altitudinis. Verbi gratia predicta positione manente dividatur 20 per 4, et exit quinarius quem quinarium multiplicabis per 8 et provenient 40 ut prius quantitas videlicet altitudinis.

7. Eodem modo potest mensurari altitudo lucente sole si cadat umbra in planum super quod magnitudo perpendiculariter erigatur. Erigatur enim virga prope terminum umbre et vide ubi radius solis tangit eam. Et per quantitatem virge que est inter contactum et planum

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1 proveniet7 provenit AEFJ

2 quantitatem...altitudinis7 distantiam inter oculum C et virgam DE M; predicta7 predictum G, prima K; positione7 divisione F, propositione H; manente7 in oriente G, stante M; dividatur7 dividantur BDELN; 207 xx A, 40 I

positione7 proportione propositione mg H

3 per^{1}7 distantiam inter oculum C et virgam DE que est add M; 47 10 M; exit7 exibit GHIK, exiet J; quinarius7 10 I, binarius M; quem7 quod K; quinarium7 denarium I, binarium M, om C; quinarius quem quinarius7 5 que 5 H; multiplicabis7 multiplicata C; 87 4 CI, 10 M; et^2 om C

4 provenient7 proveniunt ACEJM, provenit F, exibit G, exibunt HK; 407 24 (stet) G, 20 M; ut prius7 et F, que est GHK, scilicet add CI, que est add M; videlicet7 illius M, om CGIK

et illius exemplum habes in figura prima add M

5 mensurari7 scire K; cadat7 cadit DKN

6 planum7 plano G; in planum om I; quod magnitudo7 magnitudo enim C; perpendiculariter om BM; erigatur^{1}7 erigitur CGHJK; erigatur^2 om F

7 enim7 etiam N, om GHIK; umbre7 rei mensurande add M; ubi7 ut A; tangit7 tangat AEHILN; eam7 eum F, illam L

et vide7 et inde, corr mg alias et vide H

8 Et^1 om I; per om G; virge om F; contactum7 tactum BCGJ; planum7 super quod erigitur magnitudo add ADELN

multiplicetur quantitas totius umbre que est ab inferiori termino magnitudinis et conum sive terminum umbre. Productum dividatur per quantitatem umbre que est inter terminum umbre et virgam et exibit quantitas altitudinis.

8. Item aliter pone speculum in plano et procede huc illuc quousque videas altitudinem turris in speculo. Quo facto per quantitatem oculi a plano que est (237v) quantitas mensoris multiplicetur quantitas que est inter speculum et inferiorem terminum altitudinis. Productum dividatur per distantiam que est

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2 et om I; conum sive7 usque ad I, conversum N; sive terminum om GHK; Productum7 ergo add IK

3 quantitatem repeated H; que est om I

4 Productum...altitudinis om M

5 plano7 AC add M; in...procede om GHK; huc7 et add DFM, atque add GHK

Item7 Istorum (om D) duorum triangulorum latera probantur esse proportionalia per tertiam petitionem et (sive D) per (tertium B) principius libri de speculis (speculo J) et hoc est /hoc est? mg B7 principium speculo posito in plano visa (nota J) (in D) ea (eo D) aliqua (maiori? D) altitudine sicut se habet linea (a pede D) mensoris (vysoris? J) usque (om D) ad (om D) speculum (om D) ad lineam inter pedem mensoris et inferiorem (om D) partem (om D) (magnitudinis sive B) altitudinis (om D) vise (in se B, om D) (speculum D) in eadem portione se habet (om B) magnitudo (altitudi 7mg7 B) mensoris (visa D) ad altitudinem visam (mensoris D) (post altitudinis, line 9 infra D, p. 128, l. 1 J) add D, mg BJ; hoc probari potest per hoc quod anguli reflectionum (reflexivi N) sunt equales et ita (erunt illi D) trianguli similes et latera proportionalia mg EN

6 quousque7 usquequo H; videas7 videris N; turris7 AB add M; in speculo7 in medio speculi M, om I

7 oculi7 tui add M; plano7 C add M; quantitas7 scilicet altitudinis trianguli minoris vel mensoris videtur supralin A; mensoris7 minoris A, mensuratorum M, minoris add N

per 8 regulam mg D

8 inter7 D add M; speculum om M

9 altitudinis7 A add M; Productum7 ergo add I

inter pedem mensoris et speculum et exibit quantitas altitudinis.

9. Et si volueris longitudinem alicuius plani metiri erigatur virga in uno plano termino perpendiculariter et sit equalis stature mensoris. Et infigatur ei alia virga orthogonaliter. Et ponens mensor oculum in superiori termino virge perpendiculariter super planum erecte prospiciat reliquum plani terminum. Deinde signato puncto ubi radius tangit virgam huic virge orthogonaliter instantem, quantitas que est

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1 pedem] minoris *add* *N*; mensoris] minoris (mensoris *supralin*, *diff. hand*) *A*; speculum...et^1 *om* *C*; speculum] D *add* *M*; exibit] exiet *AEN*; altitudinis] quesite *add* *H*

altitudinis] ut prius in figura secunda circa illud signum *add* (*sign does not appear elsewhere*, *but drawing*, *bott mg*, *f*. *214v*, *is cut off*; *sign*: || ✣ ||) *M*

2 Et] Cum *F*, Idem *I*; si *om* *F*; plani] PQ *add* *M*; metiri] mensurare *I*; virga] PF *add* *M*

3 plano] plani *AHIL*; termino *om* *M*; virga...termino *om* *F*; sit *om* *F*; stature] visoris vel *add* *N*; mensoris] minoris (mensoris *supralin diff. hand*) *A*, mensuratione XY *M*

4 infigatur] injungatur, *corr mg* alias infigatur *H*, infingatur *I*; ei] sive ille virge sit erecte in plano *add* *M*; alia] aliqua *K*; virga *om* *ACDEFGHJKLN*, OR *add* *M*; orthogonaliter *om* *I*; ponens] ponatur *F*, pones *G*, imponens *I*; mensor] XY *add* *M*

5 in *om* *M*; superiori] inferiori *CDIJM*; Et...termino] Deinde mensor iuxta extremitatem *B*; virge] PF *add* *M*; perpendiculariter] ortogonaliter *B*; erecte *om* *CJ*

6 plani] planum *G*; terminum] termini *C*, F *add* *M*; puncto] T *add* *M*

7 virgam] OR *add* *M*; huic virge *om* *M*; orthogonaliter *om* *B*; instantem] instante *AN*, infixam *M*, et *add* *AELN*

inter punctum signatum et virgam stature mensoris equalem ducatur in quantitatem eiusdem virge equalis mensori. Productum dividatur per quantitatem que est inter oculum mensoris et punctum in quo reliqua virga infigitur et exibit quantitas longitudinis totius campi.

10. Item potest fieri per speculum ut intelligatur superior figura iacens in plano sicut ante intelligebatur erecta linea. Vero ibi

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1 punctum] T add M; virgam] PF add M; mensoris] minoris A, messoris (passim) B, minoris add N; in] inter E

Vel aliter sic. Dividatur virga equalis mensori per quantitatem que est a summitate eiusdem virge ad virgam orthogonaliter infixam. Et quod exierit multiplicetur in quantitatem virge orthogonaliter infixe que est inter virgam equalem mensori et punctum ubi radius oculi intersecat eam. Et productum erit longitudo plani mg H

2 mensori] minori A, Et add HK, perpendiculariter erecte add M; Productum] ergo add I

practica geometrie mg L

3 oculum] X add M; mensoris] minoris A; punctum] puncto, O add M

4 infigitur] infingiter (stet) K, figura (stet) M; totius] ipsius D, om I

campi] Huius (glo supralin) dictum haberi potest per quartam propositionem 6^{1} Euclidis et per 8 regulam. Et est omnino similis primo modo operandi prime practice (sa supralin) add N

5 Item] Idem AHMN, Idem add D; ut om G

Alia cautela tit I

6 linea om BGIN; Vero om FGHIKM; ibi] ante GHK

signante altitudinem iam signante plani longitudinem et reliqua linea que prius signavit planum sit linea orthogonaliter instans longitudini in plano in qua debet poni speculum.

11. Et si volueris profunditatem alicuius putei metiri erigatur super circumferentiam oris putei virga equalis stature mensoris et alia ponatur loco diametri oris putei. Deinde per summitatem virge erecte respiciat mensor oppositum punctum putei in profundo. Et consideret diligenter ubi radius secet virgam que

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1 signante^1] significate *BDN*, signans *I*, significante *K*; iam] et alia *K*; signante^2] significate *BDFN*, signans *I*, significante *K*; plani *om F*; longitudinem] planitudinem *F*, latitudinem *M*; linea] virga *DI*, *om BCJ*

2 prius] primum *M*; signavit] signavis *B*, significavit *EFGK*; sit linea *om L*; orthogonaliter] sed iacendo *supralin D*; longitudini] longitudinem *F*, lungitudinem *I*

3 qua] quo *FHIL*, *corr mg* alias in qua *H*; speculum] et cetera *add ADEGHIJKLN*

speculum] Ut patet in ista figura que est ibi *add M*

4 Et *om FI*; si] Cum *F*; volueris] altitudinem sive *add E*, profunditatem] profunditates *C*

5 circumferentiam] circumstantiam *H*; oris] NDME *add M*; putei] MNRE *add M*; virga] ML *add M*; mensoris *om CJ*

6 alia] virga *add I*; diametri] NM *add M*

7 mensor *om F*; punctum] puncti *G*; oppositum *add L*, RE *add M*; putei *om F*

8 Et *om G*; consideret] consideretur *H*; radius] tangat id est *add F*; ubi radius *repeated G*; secet] secat *CFH*

ponitur vice diametri et signetur punctus sectionis. Deinde quantitas virge erecte ducatur in quantitatem remotioris portionis diametri. Productum dividatur per propinquiorem portionem diametri et exibit quantitas profunditatis.

12. Quod si per speculum volueris idem investigare supponatur speculum et eat mensor huc et illuc quousque videat in speculo oppositum punctum profunditatis putei. Deinde quantitas que est inter oculum et planum superius in quo est speculum ducatur in

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1 ponitur] ponatur *M*; vice] loco *FM*; diametri] diademetri (*stet*) *E*; sectionis] G *add* *M*

2 virge] ML *add* *M*; remotioris *om* *M*; portionis] NG *add* *M*

Ratio operandi in hac figura satis patet in precedentibus per 8 regulam *mg* *N*

3 diametri^1 *om* *FGH*, NM *add* *M*; portionem *om* *GH*, GM add *M*; diametri^2 *om* *M*; Productum...diametri^2 *om* *C*

4 Productum...profunditas *om* *F*

5 Quod *om* *F*; idem] illud *ABEIJLMN*, *om* *CF*; investigare] scire *C*; supponatur] super ponatur *C*, supra ponatur *F*, super posito se *GH*, superposito *K*

Alia *tit* *I*

6 speculum] speculo *GHK*, proprium exibit quantitas profunditatis *add* *F*; et^1 *om* *GHK*; mensor *om* *M*; et^2] atque *GHK*, *om* *ABEIJLM*

7 punctum *om* *K*

8 oculum] speculum *FGK*; superius *om* (*lacuna*) *H*; quo *om* *F*

quantitatem que est inter speculum et cathetum qui a superiori plano ad visum punctum in puteo descendit. Productum dividatur per quantitatem que est inter speculum et cathetum ab oculo ad planum speculi ascendentem. Et de eo quod exit in divisione aufer quod est inter planum speculi et superficiem oris putei. Et quod relinquitur erit profunditas putei.

13. Quod si altitudinem aliquam inaccessibilem metiri volueris ponatur oculus in plano et erigatur cathetus note quantitatis ante oculum ita ut radius transeat per summitatem catheti ad summitatem altitudinis inaccessibilis. Deinde consideretur distantia inter

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1 quantitatem] quantitate A; que om C; speculum] oculum D; qui] quia FI; a om FIN

2 visum] illum F; in om I; Productum] ergo add I; per] in FG

3 que est (l. 1)...quantitatem om K; qui...cathetum om BCJ

4 ascendentem] ascendetis F, descendentem M; exit] erit BCDG; in divisione om M; aufer] auferas BD, au C, aufero F

ascendentem] Et exibit totus cathetus a plano speculi usque ad profunditatem putei (per quartam regulam L) add LN

5 superficiem] superiorem DF; Et^2 om CFM

6 relinquitur] remanet F, relinquetur K; profunditas] oris add G; putei om CJ

7 Quod] Et L, Item M, om AFGHIK; altitudinem] 44 supralin D; inaccessibilem] inascensibilem N

alia tit I

9 oculum] oculos J; ita ut] et I; ad] et per L; catheti ad summitatem repeated G, om L

10 inaccesibilis] inascensibilis N

oculum et cathetum; postea retrocede secundum lineam rectam quantumlibet et iterum erigatur supra illud planum cathetus idem et in eodem plano ponatur oculus ita ut radius emissus ad summitatem altitudinis transeat per summitatem catheti. Et deinde consideretur distantia inter oculum et cathetum que erit maior priore distantia. Auferatur igitur prior distantia de posteriore. Deinde per minorem distantiam multiplicetur distantia duarum stationum id est duorum

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1 cathetum7 et add FM; retrocede7 retrocedende G, retrocedat H; rectam7 directam E, om I

2 iterum om F; supra7 super FIKMN; illud7 idem DGHK; planum7 illud add M; et7 id est C

3 radius7 visibilis add B

4 altitudinis7 altitudinem J; transeat om F; et...catheti supplied in mg B; Et om BFH; deinde7 postea D; consideretur7 considera M

5 distantia^{1} om I; cathetum7 et add I; priore7 priori H

Si angulus maiori trianguli (?) ad (?) et primi propositioni mg D

6 igitur7 ergo ACHIJKMN, om F; de7 a M; posteriore7 posteriori H, ut sciatur excessus add B, supralin N, et add L; Deinde om C

7 distantia7 dicta? add C; stationum7 et habens add D; id est7 in F

Ratio huius probationis est quia si oculus esset in pede altitudinis, tunc nulla esset distantia inter oculum et cathetum quia cathetus concurreret cum altitudine sed distantia que est a pede altitudinis usque ad stationem, primam requirit sive causat minorem distantiam que est inter cathetum primum et stationem primam et distantia que est a pede altitudinis usque ad stationem secundam requirit sive causat maiorem distantiam scilicet que est inter cathetum secundum et stationem secundam; ergo sicut se habet distantia que est a pede altitudinis usque ad stationem primam ad minorem distantiam sic distantia duarum stationum ad excessum maioris distantie super minorem ducatur ergo secundum in tertium et productum dividatur per quartum et exibit primum per 8 regulam huius mg N oculorum; et productum dividatur per excessum maioris distantie super minorem. Et ei quod exit in divisione addatur distantia duarum stationum et habes totam distantiam inter ultimam stationem et inferiorem terminum altitudinis; que tota distantia si ducatur in cathetum et productum dividatur per postremam (238r) distantiam inter oculum et cathetum, exibit quantitas altitudinis inaccessibilis.

14. Quod si stans in valle altitudinem alicuius montis metiri volueris operare eodem modo sicut fecisti in quantitate inaccessibili

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1 et om ACEFIJKLM; excessum7 differentiam C; maioris7 id est maiori parti basis totius et quod sit hoc prout? probari supralin D

2 Et7 scilicet basi maioris trianguli que est a pede altitudinis usque ad primam stationem supralin N

3 habes7 habemus I; totam ends treatise, line and folio incomplete, 144v C; et^{1}...ultimam om, supplied in mg K; et^{2} om F

4 terminum om B; tota7 nota F; si om F

5 per7 in E; postremam7 posteriorem M; inter7 in F

postremam7 distantiam bott mg catchword A; productum7 per 8 regulam huius et per 4 6^{1} (Euclid) supralin N

6 cathetum7 et add BIL; exibit7 et exit F; quantitas7 tota add K; altitudinis om ABEJK; inaccessibilis om I

7 alicuius om IM

Quod7 nota mg M

8 eodem modo om I; sicut7 ut M; fecisti7 fecistis BDEJL; quantitate7 altitudine GHK; inaccessibili7 inaccesibilis I, accessibili M, inascensibili N, scilicet add I

per duas stationes retrocedendo super unam lineam rectam. Quod si super montem sita fuerit turris cuius altitudinem scire volueris quere primo altitudinem montis predicto artificio et postea totam altitudinem montis et turris similis eodem artificio. De qua tota altitudine si subtrahatur altitudo montis relinquitur altitudo turris.

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1 retrocedendo7 retrocede *M*; super *om* *M*; unam *om* *G*; Quod *om* *FI*

2 super7 supra *EF*; scire volueris *om* *E*

volueris7 *Quod si stans in monte etc* sic aree sint ABC terminus parvus posterioris stationis ad BEDE? magnus qui est similis priori ut patet. Item EFH sit parvus terminus prioris stationis /ad7 FGQK magnus qui est eidem similis ut patet. Magnum? sic qui est proportio A lateris ad AD eadem et C ad DE et que F lateris parvi ad FL eadem H ad IE, ergo que est D lateris posterioris parvi ad E eademque H ad RE, ergo permutatim que est F? et H eadem DE ad IE, ergo que est totalis C ad partem sui equalem H eadem E ad IE, ergo disiunctim que unius partis F? ad aliam eadem DI ad LE sed distantia inter duas stationes est equalis DI, ergo que unius partis C ad aliam eadem est distantia inter duos cathetos ad IE, ergo per G regulam; si pars secundi C que est quantitas minoris basis per? se? (et secunda?) quantitas in proportione facta? ultimo ducatur in Z?(3?) que Z?(3?) que est distantia duarum stationum et dividatur per primam que est minor pars C exibit quantitas CZ et E que est quantitas in ultima proportione tibi? si addatur ID sicut est equalis eadem quantitati? inter duas stationes et exhibit nota basis magni circuli que est DE, magnum sit(sic?)que est proportio A ad AD totalem eadem est C ad DE, ergo per G regulam, si ducatur primum scilicet A in ultimum scilicet M */lacuna7* FB totum ultimo agregatum et dividantur per tertium scilicet C exhibit secundum quod est ignotum scilicet AD a quo si auferatur AF cathetus exhibit scilicet profunditas vallis que quidem linea est equalitati esse intelligibili que est protracta a signo in valle ad locum supra in aere qui est locus adeo altus sicut et mons *mg* *J*

3 primo7 prius *F*, post *K*; montis7 primo sive *add* *B*; et *om* *F*; postea7 post *H*

4 similis7 simul *FJLM*, *om* *I*; et postea...artificio *om* *D*

5 si *om* *F*; montis7 et *add* *FM*; et turris...montis *om* *GH*; relinquitur7 relinquatur *I*

montis7 deficit *mg* *H*

15. Quod si stans in monte altitudinem montis sive profunditatem vallis adiacentis scire volueris, considera signum aliquod in valle. Deinde metire quantitatem basis que intercipitur inter cathetum ab oculo usque ad planum montis descendentem et sectionem communem plani montis et radii emissi ab oculo ad signum prenotatum in valle. Deinde in plano montis secundum lineam rectam retrocedendo consimilis basis quantitatem perpende que maior erit de necessitate. Deinde quantitatem minoris basis aufer de maiore. Postea quantitatem

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1 montis om M

2 adiacentis om GHKM, que (quod GHKL) idem est (om G) add (post vallis GHK) ADEFGHKLN

3 quantitatem] per alis (stet) add M; basis] minoris add N

4 ab oculo om F; planum] ex una (altera L) parte supralin EL, add N; sectionum stationem M; communem] ex alia parte N, om HM, ex altera parte supralin L

alia parte minoris mg E

5 prenotatum] prenominatum GHK

practica geometrie mg KL

6 et...montis om F; retrocedendo] retrocede M

retrocedendo] ut prius si? habeat linea ante si? postea add F

7 consimilis] similis H; maior] priori (priore G) add GHK; erit] exit M

basis] id est basem respondentem consimili catheto supralin N

8 de] a K; maiore] maiori HK

aufer] ut sciat excessus supralin N

minoris basis duc in distantiam duarum stationum quod est spatium inter duos cathetos ab oculo in duabus stationibus ad planum montis dimissos. Productum divide per excessum maioris basis super minorem et ei quod exit in divisione addatur distantia duarum stationum. Totum aggregatum multiplicetur per cathetum inter oculum et planum montis. Productum dividatur per quantitatem maioris basis et de eo quod exit in divisione auferatur predictus cathetus inter oculum et planum montis et quod relinquitur est profunditas vallis.

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1 minoris] maioris H; basis om F; aufer...basis om G; quod] que E

minoris] ratio huius probationis patet per id quod notavi in materiem huius pagine de mensura altitudinis inaccessibilis supralin N

3 divide] dividatur H

4 ei om F; quod] que E; addatur] additur N

divisione] et erit in divisione tota basis maioris trianguli preter basim posterioris turris mg N

6 basis om J

maioris] et erit linea composita ex altitudine montis et mensoris mg N

7 cathetum...montis] quantitatem duarum stationum M; quod] illius add M; est] erit GHKM, repeated E, ibi add M; vallis] sive altitudo montis add GHK

per 8 regulam huius et per 4 6^{i} (Euclid) supralin N

16. Quod si stans in monte turrim stantem in valle metiri volueris, metire prius profunditatem vallis ad basim turris predicto modo. Deinde scrutare profunditatem vallis ad summitatem turris simili artificio. Postea subtrahe minorem quantitatem inventam de maiori et quod relinquitur est altitudo turris.

17. Et ut premisse mensurationes et consimiles verius fiant et facilius, paretur gnomonicum instrumentum forma videlicet quadrata convenientis quantitatis cuius duo latera que angulariter conveniunt

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1 stantem7 instantem J

id est quantum erit a superiori parte vallis usque ad basem turris supralin N

2 metire om F; prius om BJ; ad7 et GH

3 scrutare7 scrutaris F; simili7 consimili F

Deinde7 id est quantum erit a superiori parte vallis usque ad summitatem turris supralin N

4 artificio om F; inventam om H; maiori7 maiore KN

5 et om J; quod om GHK; relinquitur7 relinquetur K; est om GHK; Quod (p. 140, l. 1)...turris om I

6 Et ut7 Et BJ (Et ut supplied in mg J), Vel autem D, Ut (autem H) FH; premisse7 predicto modo F, predicte I; mensurationes7 commensurationes JN; et^2 om I; consimiles7 similes GH, om I, illius add D; premisse...consimiles7 predicte commensurationes B; verius om D; fiant7 fient B, fuerint N

7 paretur7 patebit BDFM; gnomonicum7 gnomonis BGJ, gogoantum I, gnomonum M, in add G; instrumentum7 instrumento BD; videlicet7 esse F

8 conveniunt7 conveniant H, convenerint J

dividantur utrumque in 12 partes equales que appellantur digiti gnomonis. Postea quilibet digitus si poteris dividatur in 60 partes equales que appellantur puncta digitorum et ita erunt in utroque latere 720 et si hoc pro brevitate instrumenti fieri non potest, dividatur quilibet digitus in 5 partes et erunt in toto latere 60 partes quarum quelibet valebit 12 puncta. Deinde in angulo quadrati qui opponitur illi angulo ubi predicta latera angulariter conveniunt inseratur cum clavo regula ad modum regule in astrolabio cuius unum

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1 dividantur] dividatur FIM; utrumque om BF, latus add I; 12] xii G, 2 M; que] quod N; appellantur] appellabuntur H

digiti mg H

2 gnomonis om H; digiti gnomonis] digitgronos et I; que...gnomonis om F; dividatur om I; in] per FKN; 60] 6 M

3 appellantur] apelabuntur (stet) H; puncta] puncti H; ita] illa M; erunt] erit H

4 720] et cetera ubi supra digiti gnomonis H, puncta add BD; instrumenti] et cetera add, then Postea...instrumenti repeated H; potest] poterit I

credo quod sic debeat dicere mg H

5 dividatur] dividetur M; quilibet digitus om F; partes] equales add I; et] ita add I; erunt] erit H; toto] utroque I, vero M; 60] 6 G

6 partes] equales add I; in om I; in angulo] triangulo (stet) M

7 ubi] ut F; conveniunt] convenerunt J

8 inseratur] infigatur I; cum] ter (stet) I; unum om M

latus diagonalis ab angulo in angulum ducte possit adiacere. Et super eius duos terminos erigantur due pinnule in quibus trahantur due linee orthogonaliter erecte super latus regule predictum. Et in illis lineis sic tractis fiant duo foramina equalia et in equali distantia a superficie regule et sit ita insertus terminus regule in angulo dicto ut alter terminus sursum et deorsum de facili moveri possit super superficiem quadrati.

18. Quo facto erigatur instrumentum illud super unum latus divisum tali conditione ut illud latus sit in equidistantia orizontis et

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1 diagonalis] dyagonaliter *FH*, dyagonali *GJM*, diagnoali *IK*; ducte] ductum *F*, ducto *I*, directe *LN*; possit] postea *F*; adiacere] ad tactus *F*

ducte] directe vel ductum *mg H*

2 duos *om F*; erigantur *om B*; due *om M*; pinnule] penultime *BGH*, penule *E*; trahantur] subtrahantur (stet) *M*

3 predictum] predicte *I*

4 Et^1 *om M*; lineis *om F*; tractis] protractis *BF*; fiant] fiunt *M*; duo *om GHK*; in^2 *om F*

5 superficie] superficiei *M*; regule] predicte *add AELN*; insertus] infimus *J*, *om BF*

6 regule] predicte *add AELN*; et...regule *om F*; alter] aliter *K*; sursum] seorsum *M*; de *om K*

7 facili] faciliter *K*; super *om G*; superficiem] faciem *H*, superficie *K*

8 illud] istud *M*, *om GHK*

9 latus *om GH*; divisum...latus *om FM*; sit in] ut sit *F*; equidistantia] equali distantia *BFIJK*; orizontis] orientis *M*, vel magnitudinis *add L*

reliquum latus divisum super planum orizontis orthogonaliter erectum et angulus in quo regula inserta est sit versus altitudinem metiendam. (238v) Hoc facto move regulam quousque videas per duo foramina summitatem rei metiende. Et si ceciderit regula super latus iacens, considera quantitatem basis inter regulam et latus indivisum. Quo facto retrahatur instrumentum secundum rectam lineam supra quam erectum est. Et iterum move regulam quousque videas per duo foramina summitatem altitudinis metiende. Et si ceciderit regula super latus inferius ut prius considera iterum quantitatem basis inter regulam et latus indivisum. Postea

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1 reliquum] relinquendo F, id est magnitudinis vise supralin N; divisum] deorsum EF; orizontis om F

2 inserta] sita FM; est om F

3 move regulam] moveatur B, intue illam G; quousque] donec G; videas] vides J

4 metiende] metiendi M; Hoc...metiende om I; regula] linea I, om F, sive libra add AEKLN; super] supra N

5 iacens om I; et latus] etiam G; inter...latus] in regula H

6 indivisum] divisum FGI; secundum] super M

basis inter regulam et latus indivisum mg H

7 supra] super GHIKM; erectum est] erigatur I; iterum] deinde I; move] moveas H

8 per om G; summitatem] rei add M

9 Et...regula repeated M; super latus om G; inferius] interius, corr mg inferius H, inferioris I, ipsius add AELN; iterum] item H, om F

10 indivisum] divisam, corr mg indivisum H

per excessum maioris basis super minorem et per distantiam duarum stationum que est spatium inter duo loca ubi cadit inferior terminus regule in duobus sitibus subtiliter in plano notatis operare sicut predictum est in aliis practicis, quod est ut minorem basim ducas in distantiam duarum stationum. Productum dividas per excessum maioris basis super minorem, et ei quod exit in divisione addatur predicta distantia et totum aggregatum per latus instrumenti multiplicetur. Productum dividatur per maiorem basim et exit quantitas altitudinis.

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1 idest tota basis minoris trianguli et habebis distantiam a loco ubi primo cadit regula usque ad inferiorem terminum altitudinis hac basis habita faciliter si sapis? habebis propositum *mg* *N*

2 loca] latera *M*

3 in plano *om* *M*; notatis] notans *BJ*, et *add* *B*

4 predictum] dictum *FG*, prius dictum *M*; est^1] quod cum *add* *B*, practicis *add* *N*; ut] in *I*, *om* *GK*; quod est ut] quidem *H*; minorem] maiorem (quantitatem *I*) *BHIJ*

5 stationum] et *add* *L*; Productum] vero *add* *I*; in...excessum *om* *F*

6 exit] erit *H*; predicta] supradicta *I*

7 distantia *om* *F*, duarum stationum *supralin* *N*; totum] iterum *BFN*; aggregatum] congregatum *I*

8 Productum] Predictum *A*, vero *add* *I*; dividatur] divide *M*; maiorem] minorem *IK*; exit] exibit *GHK*, exiet *I*, indivisum *supralin* *N*; altitudinis] et cetera *add* *M*

maiorem quantitatem *mg* *H*

19. Quod si regula ceciderit super latus divisum erectum ducatur latus in se. Productum dividatur per partem lateris supra regulam et quod exit in divisione erit basis quesita incohata ab inferiori termino lateris a fixione regule descendentis. Et ubi terminatur illa basis erit una stationum. Per simile altitudinem montis et turris super montem sicut dictum est in aliis practicis hoc instrumento potes invenire.

20. Et si stans in monte profunditatem vallis hoc instrumento

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1 ceciderit om F; latus om M; divisum7 exterius add L

2 partem7 partes K; supra7 super IM; regulam7 quam BN; et om ADEF IJLM

se7 vel sicut ducatur latus divisum in se; productum dividatur per illud quod est supra regulam et exit basis qui est longitudo soli? predicti? vel add F; per 8 regulam huius et per 4 6^1 (Euclid) hic sunt duo latera trianguli similes et sicut basis magna maioris depende? a regula ita et latus superius ad partem lateris supra turrim? ut supralin N; practica geometrie mg L

3 exit om K; divisione7 metiende F; quesita7 primo loco add AELN, prius add D; incohata7 inotata B, ends treatise, 145v D; ab inferiori7 a superiore I

4 a fixione7 affixione M

Et7 in pagina precedente supralin N

5 erit7 exit F, est M; stationum7 posteriorum add N; simile7 opus add GHK; altitudinem7 altitudinis BEIJLN

6 sicut om F; dictum7 dicendum F

7 hoc instrumento om H; potes7 poteris GHKL, om AEFN; invenire7 invenires N, om F; Per...invenire om I

8 hoc om J, est add I; instrumento om J

scire volueris, erigatur instrumentum predicto modo et emittat radium per superius pinnule foramen quousque per inferius foramen aliquod signum in valle videas. Et si inferior terminus regule tangat latus iacens, considera quantitatem basis inter regulam et cathetum et retrahe instrumentum secundum rectam lineam, et iterum considera quantitatem basis inter regulam et cathetum; et per excessum maioris basis super minorem et distantiam duarum stationum operare, ut predictum est in practica de profunditate vallis, hoc est ut per minorem basim multiplicetur distantia duarum stationum que est spatium inter duos cathetos in duobus sitibus.

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1 hoc...scire] metiri BL; instrumentum] hoc add F; predicto] verbi gratia add F; emittat] emittet AN

2 superius] superioris H; quousque om B; inferius] inferioris HK, pinnule add GHK

3 signum] signatum I; videas] videat AGHIJKLM, videatur EN

4 tangat] tangit J

5 rectam om M

6 lineam om J

7 et retrahe...cathetum om BIN; inter...basis om M; et^{2} om K; distantiam] distantia B, om K

8 duarum] ductum G; ut] ubi H, om FM; de] in M

in pagina precedente et patet per primam figuram huius pagine supralin N

9 ut om F; multiplicetur] multiplica F; distantia] distantiam FN, inter add F

10 in om F; sitibus om F

Quod provenit dividatur per excessum maioris basis super minorem. Et ei quod exit in divisione addatur predicta distantia; totum aggregatum multiplicetur per latus instrumenti. Productum dividatur per maiorem basim. Et de eo quod exit in divisione aufer ipsum latus; quod relinquitur est profunditas vallis. Si vero regula ceciderit super latus erectum operare sicut dictum est in predicta practica et habes basim quesitam. Ad longitudinem plani metiendam ducatur latus divisum in se, productum dividatur per illud quod

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1 provenit] provenerit *I*; dividatur] ducatur *K*, *om I*

2 Et *om K*; exit] erit *H*; predicta *om BJ*; distantia] differentia *I*; totum] ergo *add I*

distantia] et habebis totam basim que procedit a signo in valle usque ad locum sub monte e directo posterioris stationis *add E*, *mg N*

3 aggregatum *om F*

4 Et] ut *B*; exit] erit *H*

5 latus] eius *G*, ei *add I*; quod] et *GH*, *om K*; relinquitur] relinquetur *GHK*; est *om GHK*; vallis] et cetera *add M*

6 operare] operetur *FIM*; sicut] ut *FGHIM*; dictum] predictum *AEILN*; in *om BJN*; predicta] precedenti *BGHIKM*

in hac pagina *supralin N*

7 habes] habebis *GH*, habemus *I*

longitudinem] scilicet quando regula cadit super latus erectum *supralin N*

8 illud] id *AEN*

est supra regulam et exit basis que est longitudo plani. Multa alia subtilia fieri possunt per illud instrumentum que diligentis practica sollertia facillime investigabit ut de quantitate umbre iacentis per umbram versam et econtrario. De proportione altitudinis ad suam umbram. Et de cognitione quis duorum montium sit altior. Et de plano metiendo et consimilibus.

21. Et si in aliqua premissarum operationum mensuraveris per palmos et contingit tibi aliquid preter integrum numerum palmorum

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1 exit7 longitudo *add B*; Ad...plani *om FGHIKM*; Multa7 autem *add I*

2 alia7 autem *BFG*; subtilia *om M*; possunt7 possent *K*; illud7 istud *GHKMN*; que7 qui *I*

long, illegible note mg J

3 practica7 practici *AEGHJKM*, practice *FI*; sollertia7 solsticia *I*; facillime *om M*; investigabit7 investigabat *M*; umbre7 vel *add G*

4 iacentis *om, supplied in mg H*; per7 super *K*; econtrario7 econverso *HK*, Et *add HN*; ut...econtrario *om L*

5 cognitione7 autem *add B*; quis7 uter *BIJ*, utrum *F*; montium7 iterum *add I*; quis...montium7 ut duorum montium quis *AE*

6 sit *om N*; altior *om BN*, sit *add B*; Et^1 *om F*; et^{2}7 sit de *add F*, de *add JM*; consimilibus7 similibus *GK*

7 Et7 ut *F*; si in7 sine *HJ*; operationum7 mensurationum *HKM*, *om G*; mensuraveris7 mensurandis *B*, mensurationem *F*, mensurantis *M*

8 palmos7 planos *B*, palmarum *M*, operis *add F*; contingit7 contigit *EHMN*, contingeritur *F*, contigerit *GIKL*; tibi *om F*; aliquid7 aliud *F*; numerum *om M*; palmorum7 planorum *B*

minus palmo, divide unum palmum in 60 vel quotlibet partes velis et vide quot illarum partium contineat pars palmi relicta. Ita quod non fiat error sensibilis. Postea per numerum per quem divisisti unum palmum multiplica integrum numerum palmorum, et adde partes illas. Et in similes partes resolve omnes palmos cum quibus operari debes multiplicando vel dividendo. Et cum provenerit tibi ultimo quod queris in huius minutiis. Divide numerum harum partium per numerum per quem divisisti unum palmum. Et quod exit in divisione erit

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1 palmo] plano *B*, palma *M*; palmum] planum *B*, *om F*; in *om F*; 60] partes *add I*; vel] in *add AEFN*; quotlibet] (per *G*) quot *GHK*, quaslibet *I*; velis] velitis *A*, volueris *EFGHIKN*, vis *L*

2 vide] quod *add G*; relicta] relicti *BGJ*; palmi relicta] palbilis *I*; quod *om F*

3 fiat] relinquetur *AE*, relinquitur *FLN*, reliquatur *M*; Ita...sensibilis *om I*; contineat...Postea *om B*; per^1 *om F*; per^2 *om I*; quem] quam *M*

4 palmum] planum *B*; integrum] unum *K*; palmorum *om I*; adde] addes *J*

5 palmos] palmas *M*; cum *om HL*; quibus *supplied in mg H*, hoc huius minutiis *add L*; debes] in *add I*

6 vel] et *IK*; provenerit] venerit *JN*, provenit *L*

7 in] omni *add G*; huius] hoc in (*om K*) *AEKLM*, hoc modo in *G*; minutiis] numerum *F*; in huius minutiis *om I*; Divide] Divido *J*; harum] aliarum *F*, earum *G*; partium...harum *supplied in mg J*

huiusmodi *mg H*

8 per *om FIM*; palmum] planum *B*; multiplica...palmum *om B*; quod] que *E*; exit] erit *H*

numerus (*239r*) palmorum integrorum. Quod relinquitur erunt partes unius palmi a numero divisoris denominate; similiter operare de aliis mensuris.

22. Sequitur de planimetria id est mensura planorum superficierum. Sed nota quod sicut per lineam datam secundum palmum vel pedem mensuramus lineam ita per superficiem datam mensuramus superficiem. Superficies autem data est quadratum palmi vel pedis vel cuiuslibet mensure date et appellatur palmus contractus vel pes contractus.

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1 palmorum] planorum *B*; integrorum] et *add AEGHILN*; relinquitur] relinquetur *L*; erunt] erit *HJ*

numerus] palmorum *bott mg catchword A*

2 unius *om F*; palmi] plani *B*, huius *add F*; divisoris] divisionis *I*; denominate] denominatio *BL*, notate *F*, denominato *J*, denominante *M*; operare *om BL*; de] in *EGHK*

3 mensuris] instrumentis *BFGJ*, et cetera *add*, *end of treatise*, *217v M*

4 planimetria] plana mensura *I*; est] de *add ELN*; id est] in *K*; mensura] mensurarum *I*; planorum] planarum *AEFGHIJKLN*

5 quod om *AEGHIJLN*; datam] ductam *K*; secundum] vel *BFMN*; palmum] planum *F*, palmam *J*; pedem] vel aliam mensuram *add GHK*

6 ita *repeated E*; per *om IJ*

7 autem] que *I*; est] id est *add I*; palmi] plani *BFIJ*; vel^1 *om I*; pedis] pedem *BIK*, *om I*; cuiuslibet] alicuius *BJL*, cuiuscumque *F*

8 palmus *om F*; contractus^1] constractus *AGHKLN*, constratus *J*; vel] sive *F*, ut *G*, ubi *corr mg* vel *H*; contractus^2] constractus *ABGHKLN*, constratus *J*

constractus^2] et sic de aliis *add GHK*; id est quadratus *supralin N*

23. Quod si volueris scire quantitatem alicuius quadrate superficiei considera proportionem unius lateris ad mensuram per quam mensurare volueris et duc illam proportionem in se: productum erit area quadrati. Verbi gratia latus quadrati sit 12 pedum mensura 4 pedum; proportio duodecim ad 4 est tripla, duc ergo tria in se et habes novem. Et sic quadratum nonuplum erit ad quadratum mensure. Si fuerit rectangula superficies duc quantitatem unius lateris in quantitatem alterius lateris id est numerum secundum

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1 Quod *om* *GHIK*; si7 igitur *add* *GH*, ergo *add* *K*; quantitatem *om* *J*; quadrate superficiei *om* *N*

2 proportionem7 quantitatum proportionum *H*, quadrate superficiei *add* *BJ*; unius7 alicuius *N*; lateris7 locī *I*

Probatio? huius? est? per 24' 6^{ti} vel ex correlario? 17^{e} 6^{ti} (*Euclid*) *mg* *L*

3 et duc *repeated* *E*; proportionem7 portionem *F*; productum7 ergo *add* *I*

4 sit7 erit *L*; 127 21 *L*; pedum7 sed *I*

5 mensura 4 pedum *om* *K*; est *om* *ABEFJLN*, secundum *add* *I*; tria7 tres *AEJ*, ter *B*

6 et^{1}7 sic *add* *I*; quadratum7 quadraprohatur? *F*; nonuplum7 notuplum *BIJL*, aliomtuplum? *F*; erit7 est *I*; ad7 in *F*

7 mensure7 Et *add* *K*; rectangula7 recta glinea, *corr* *mg* rectiangula *H*

tertia regula *mg* *H*; Probatio huius est per 26 Euclidis vel ex correllario 17 sexti et per 9 diffinitionem quinti Euclidis et per 18 6^{1} *mg* *N*

8 quantitatem7 quantitate *H*

practica geometrie *mg* *L*

quem mensura tua est in uno latere in numero secundum quem est in alio latere et habebis aream rectanguli.

24. Quod si fuerit superficies triangula aut erit ambligonia aut orthogonia aut oxigonia. Si orthogonia, duc unum latus rectum angulum continentium in reliquum, id est numerus secundum quem mensura tua est; et tibi producti medietas erit area trianguli. Si ambligonia, ab angulo obtuso ducatur perpendicularis ad basem et numerum secundum quem mensura tua est in illa perpendiculari

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1 tua est] erit *F*; numero] numerum *AEGHN*; est^2] qui *G*
numero] scilicet pes constractus *supralin* *N*

2 in numero...latere *om* *I*; habebis] habes *AIN*; aream] haream (*stet*) *G*

3 Quod *om* *I*; triangula] trianguli *BH*, rectangula *G*; erit] ergo *I*; ambligonia] ambligona (*passim*) *HK*

4 orthogonia] orthogona (*passim*) *HK*; oxigonia] oxigona (*passim*) *HK*, exigonia *N*; Si *om* *G*; orthogonia *om* *G*, ABC *supralin* *F*; duc] ergo *add* *I*

5 rectum angulum] rectangulum *BIJKL*; id est] et *F*; numerum] numerus *J*

6 tua est *om* *I*; tibi] cetera *AFN*, *om* *L*, cuius (ut supra *supralin*) *G*; mensura...tibi] et cetera (ut supra *K*) *FIJK*; id...tibi] et *B*; producti] ergo *add* *I*; mensura...producti] et cuius ut supradocui *H*

7 ambligonia] DEFG *supralin* *F*; obtuso] octuso *G*; perpendicularis] linea *add* *FI*

8 numerum] numerus *AEIJ*; in *om* *I*

ducatur in numerum secundum quem est in latere subtenso obtuso angulo. Producti medietas erit area quesita. Similiter si fuerit triangulus oxigonius ab uno angulo descendat perpendicularis super basem et numerus secundum quem mensura tua est in illo perpendiculari ducatur in numerum basis. Producti medietas erit area trianguli.

25. Si habueris figuram multilateram que sit equilatera et equiangula, a medio puncto unius lateris trahatur intra figuram perpendicularis et a medio puncto alterius lateris similiter et vide quotiens mensura tua sit in altera illarum usque ad concursum et conserva numerum. Postea numerum secundum quem mensura tua est in uno latere multiplica per numerum qui designat quot latera habet

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1 ducatur] duc AEGHJKL; in^1 om G; est om I; subtenso om F

2 angulo] et add J; Producti] ergo add I; erit] est BGK; Similiter] Quod F, om BI

3 triangulus om I; oxigonius] ABCD supralin F; uno] una K; angulo] triangulo N; descendat] descendente F; super] ad AGIK

4 basem om A; mensura repeated E; illo] illa AFGHIJKLN, parte add F

5 Producti] ergo add I; erit] est AEHIKL; trianguli] Ut add F, Et add H

6 habueris] habuerimus F, habuerit G

7 lateris om I; intra] infra E, inter I, om G

8 et^1 om GH; unius...et^1 om J; a...puncto om B, supplied in mg J; alterius] proximi GHK; lateris] puncto add N; similiter] perpendicularium supralin N; lateris similiter supplied in mg B

9 et vide] et inde GH, corr mg et vide H; sit] est H

10 et om FG; Postea] per add H; quem om F; est om K

11 latere] laterum BJ, lateram N, principalis figure supralin N; per om H; quot] quota I; habet] habeat FIJN

figura. Productum iterum multiplica per numerum prius servatum. Totius medietas erit area figure.

26. Et si fuerit planum equidistantium laterum et non rectangulum ab uno latere ad oppositum ducatur perpendicularis et numerum secundum quem mensura tua est in illo perpendiculari duc in numerum secundum quem mensura tua est in altero laterum cui perpendicularis superstat et provenit area plani. Et si planum huius fuerit multilaterum et non fuerit equilaterum vel equiangulum dividatur in triangulos et scrutentur aree triangulorum partialium iuxta

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1 figura] illa quod add B; Productum] numerum add I; qui...numerum om EF; servatum] conservatum B, sumptum et I

2 Totius] cuius F, producti add GHK; medietas] medietatis G

3 Et^{1}] Ut F; fuerit] sit I, aliod certificium add F; et^{2} om F; rectangulum] rectum angulum H; et non rectangulum om BI

4 ad] latus add BIK; et] in H; numerum] numerus I

5 tua om J; illo] illa AEHIKL, om N; in illo] illam G

6 in illo...est om F; laterum cui] latere F

7 superstat] substat F; provenit] proveniet AGHIKLN; duc...provenit] ut G; plani] plana F; Et^{2}] Ut F; huius om J, modi add KN; fuerit om N

8 multilaterum] multiplicatum G; huius...et om B; non] huius F; multilaterum...fuerit om F; vel equiangulum om H

9 scrutentur] querantur GHK; iuxta] per I

iuxta mg H

premissas practicas et aggregentur simul et provenit area plani multilateri.

27. Et si planum fuerit circulare, numerus secundum quem mensura tua est in semidiametro illius circuli ducatur in numerum secundum quem mensura tua est in circumferentia. Producti medietas erit area circuli. Et si per diametrum volueris scire circumferentiam vel econtrario, numerus secundum quem mensura tua est in diametro si diameter est notus ducatur in 22, productum divide per 7. Et exit numerus secundum quem numerus tuus est in circumferentia. Quod si circumferentia est nota, duc numerum

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1 et^{1}7 ut F; simul7 similis JN; provenit7 proveniet GHIKL

2 multilateri7 multilateris I

3 Et7 Ut F; circulare7 circuale J

4 tua om J; mensura tua7 numerus tuus B; est om L; in^{1}7 circumferentie add J; circuli om GHK

5 quem7 quoniam K; mensura om GHK; tua om GHJK; est om L; circumferentia7 et add I

6 circuli7 circularis F; Et7 Ut F; per om G

7 vel7 et N, om GHK; econtrario om GHK; numerus7 numerum HK; mensura7 id est latus mensure supra in L

8 notus7 nota L; si...notus om HK; ducatur7 duc HJK; 227 12 B, 2 F, et add J; productum7 ergo add I

9 77 vii H; exit7 erit H, exiet I; Et exit repeated B; quem7 quod N; numerus tuus7 mensura tua (om F) EFHIJKLN; diametro...in om G

10 Quod7 Et I; est7 sit FGHK, om L; Et...numerum om I

secundum quem mensura tua est in circumferentia in 7 productum divide per 22, et exibit numerus secundum quem mensura tua est in diametro. Ex hoc etiam patet qualiter area semicirculi practice inveniatur. Et si proposita fuerit portio minor semicirculo numerum secundum quem mensura tua est in arcu portionis duc in numerum secundum quem quadrata mensura tua est in area circuli. Productum divide per numerum secundum quem mensura tua est in tota circumferentia. Et de eo quod exit in divisione aufer aream trianguli que sub corda portionis et duabus semidiametris

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1 tua om F; in^{1}] diametri add G; 7] se F

2 22] 21 F; exibit] exit BFJ, exiet I; tua om J

3 Ex] Et I, om GH; hoc] hac H; etiam om H; area om F; semicirculi] circuli I, semicirculari K; practice om L

4 inveniatur om F; Et] ut F, Item I, om K; si om H; fuerit] sit in F; portio] proportio FGIJ

5 numerum] numerus EIJ; est] sit add F; portionis] proportionis F; duc] ducatur L; in^{2}] illum E, om F

6 tua om BGJ

7 per] secundum I; tua om B; est] et I; tota om F

8 de] ab GHK; eo] (?)o (illegible) add I; quod] que E; exit] erit GH; aufer] auferatur G; aream] a F

9 trianguli] triangulo F; que] qui AEFIJLN; corda] ordine I; portionis] proportionis FI; duabus] duobus GHIK; semidiametris supplied in mg, circumferentialis add B

continetur. Et relinquitur numerus secundum quem quadrata mensura tua est in data portione. Quod si portio fuerit maior (*239v*) semicirculo quere aream portionis que deest ad perfectionem circuli et subtrahe illam de area totius circuli et relinquitur area data.

28. Et si volueris scire aream superficiei data columpne numerum secundum quem mensura tua est in latere date columpne duc in numerum secundum quem mensura tua est in circumferentia basis columpne. Et numerus qui provenit est numerus secundum quem quadrata mensura tua est in area superficiei columpne. Et si totam superficiem columpne scire volueris quere aream duorum

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1 relinquitur] relinquetur *HK*, relinquatur *I*; numerus *om* *G*

2 data] tota *G*; portione] proportione *AF*; portio] proportio *AF*

3 que deest] predicte *H*

4 illam] eam *FL*; ad...area] ab integritate *I*; relinquitur] relinquetur *HKL*, relinquatur *I*; date *om* *F*

5 Et] ut *F*, *om* *I*; aream] in *add* *J*

6 duc] ducatur *BI*, secundum *add* *F*; in^{2} *om* *I*

duc] aliter divide *mg* *G*

7 mensura tua *om* *GHK*

8 columpne *om* *GHK*; numerus^{1} *om* *G*; provenit] proveniet *KN*

9 quadrata *om* *I*; tua *om* *B*; est *om* *F*; columpne] occulte *add* *AEL*, date *add* *I*; Et *om* *H*

10 columpne *om* *F*, rotunde *add* *N*; aream] areas *EFHKLN*

circulorum basium et adde predicte aree curve et habes quod queris. Et si fuerit area pyramidalis rotunda duc numerum secundum quem mensura tua est in ypothenusa pyramidis in numerum secundum quem mensura tua est in circumferentia basis. Producti medietas erit area superficiei. Cui si addideris quantitatem circuli basis habes totam superficiem pyramidis. Et si volueris scire areasm superficiei date spere duc numerum secundum quem mensura tua est in diametro spere in numerum secundum quem mensura tua est in circumferentia maximi circuli in spera. Et proveniet numerus secundum quem quadrata mensura tua est in area superficiei spere. Et si aream curve superficiei

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1 habes7 habebis *FHK*

2 Et7 ut *F*, *om* *I*; area *om* *H*; rotunda7 rotundi *BJ*; duc7 in *add* *FL*

3 ypothenusa7 ypodensa ypotensa *H*; pyramidis7 pyranidis, *corr* *mg* piramidis *H*

practica geometrie *mg* *L*

4 in...est *om* *AB*, *supplied in mg* *J*; in *om* *G*; basis7 et *add* *I*; area7 quadrate *add* *B*

5 superficiei7 pyramidis *add* *FGHIK*; Cui7 Aut *H*; circuli *om* *H*; quantitatem circuli7 quadrantem *G*; habes7 habebis *GH*, ostendet *J*

6 Et7 Ut *F*; aream superficiei7 superficiei *K*, superficiem *N*; date *om* *I*

7 spere^{1} *om* *I*; diametro7 date *add* *I*; spere^{2}7 est *add* *L*; in...spere^{2} *om* *B*

8 secundum *om* *H*; in diametro...est *om* *EF*, *supplied in mg* *J*

9 proveniet7 provenit *AEIJLN*; numerus7 motus *L*

10 in diametro...est *om* *F*; curve *om* *I*

cupe date metiri volueris, numerum secundum quem mensura tua est in latere cupe duc in numerum secundum quem mensura tua est in medietate circumferentie oris cupe et iterum in medietate circumferentie basis cupe et aggrega producta, et proveniet numerus secundum quem mensura tua quadrata est in area curve superficiei date cupe.

29. Quod si in aliquo opere planimetrie aliquam superficiem per minorem superficiem illi similem mensurare volueris sume proportionem unius lateris maioris ad corelativum latus minoris et duc eam in se, et proveniet numerus secundum quod minor superficies est in maiore. Et si in aliqua predictarum practicarum contingat quod fuerit mensura

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1 date om I; volueris7 secundum add I

2 cupe7 date add K; est om F; medietate7 latere H

3 oris om I; medietate om F; oris...circumferentie^2 om E; basis7 oris I

4 aggrega7 congrega BGJ, aggregata K; proveniet7 provenit AEJLN, provenerit G

5 est om F

6 Quod om I; aliquo om I; aliquam7 aliam FI

7 per...superficiem om GH; proportionem7 proportionis B, portionem I

sume7 in circulo dyametri ad dyametrum vel circumferentie (circumferentia I) ad circumferentiam add FGHIK

8 maioris7 minoris I; corelativum7 corelatium K; latus7 lateris BEGJ

9 proveniet7 provenit AELN; numerus7 minor add B; secundum om F; quod7 quem AEHIN, om F; minor7 maior A; maiore7 maiori FH, superficie add F

tua aliquotiens in aliqua linea et preterea aliquod minus illa vel quadrata superficies tua aliquotiens in area aliqua et preterea minus illa, divide mensuram tuam in 60 vel secundum denominationem quam volueris et vide quot illarum partium relicta quantitas contineat ita quod non relinquatur error sensibilis. Et operare secundum opus minutiarum sicut superius in practicis altimetrie pretetigimus.

30. Sequitur de steriometria. Et nota quod sicut in altimetria lineam rationalem per quam metimus altitudines et in planimetria per quam metimus superificies ita in steriometria, sumimus corpus rationale videlicet cubum aut columpnellam aut sperulam aut simile

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1 tua om I; aliquod7 aliquid AEHIK, aliud F; vel7 ut BGJL

2 superficies7 mensura GHK; in7 linea add G; et7 etiam H; preterea7 aliquid add K

3 mensuram tuam7 mensura tua I; 607 partes add EILN; secundum7 in quantam F; denominationem7 detractionem I, tuam add G; quam om F

4 relicta7 reliqua J; quantitas7 pars I

5 quod7 ut GH; relinquatur7 relinquitur J

6 sicut7 ut H; pretetigimus7 tetigimus FGHK, end of treatise, 35v^a I, primo tetigimus J

in principio pagine precedentis supralin N

8 lineam7 sumimus lineam add B; metimus7 metimur ABEGHKLN; altitudines7 altitudinem E, altitudinis H, sive longitudines add GHK; et om N; planimetria7 superficiem ratinalem add AEFJL

9 quam om ABEL; metimus7 metimur ABEL, om J; per...metimus (metimur B) repeated B, om GHKN; superficies7 superficiem GKN, rationalem add N; ita7 sic N; per...steriometria om N

10 cubum7 cubitum BGJ; aut^{1}7 vel H; columpnellam7 columpnare B, columpnam J; aut^2 om J; sperulam7 spericam J; aut^{3}7 sive AELN, vel J

quid. Quod si per cubum parvum vel cubum magnum metiri volueris, considera proportionem lateris maioris ad latus minoris et illam proportionem triplica et duc denominationem in suum quadratum et proveniet numerus secundum quem minor cubus est in maiore. Similiter si columpnam per columpnellam metiri volueris et fuerint similes, duc proportionem axis ad axem in suum quadratum vel

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1 cubum^{1}] cubitum BJ, id est corpus quadratum supralin N; vel om AEGKLN; cubum^{2}] cubitum BJ; volueris] velis AEGKLN, voluerimus F

quid] per quod metimur corporales dimensiones add B

2 considera] considerabimus F; proportionem] proportionis B; ad latus] altitudinis GH

3 triplica] triplata F, tripla GH; et^{1}] id est EGHJKLN; suum quadratum] suo quadrato F

4 proveniet] provenit FJ; est] sit G; in om G

maiore] Ex 36 11 et 10 definitione quinti supralin N

5 Similiter] Aliter B; columpnellam] columpnam F; et] si add G; fuerint] sint B

Hoc probatur per primam petitionem Archimenides de quadratura circuli scilicet cuilibet recte linee aliam lineam esse equalem et per precedentem practicam de triangulo rectangulo mg N

6 axis] assis G; ad axem om F; vel] ut F

diametri basis ad diametrum basis quod idem est. Et proveniet numerus secundum quem columpnella est in columpna. Similitudo columpnarum vel pyramidum rotundarum est quod sicut proportio axis ad axem sic diameter basis ad diametrum basis. Similiter operaberis si pyramidem per pyramidellam metiri volueris. Et si speram per sperullam metiri volueris, duces proportionem diametri ad diametrum in suum quadratum vel circumferentie ad circumferentiam que eadem

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1 proveniet7 provenit F

2 quem om B; columpnella7 columpna FG; est om G

numerus7 per 10 12' (Euclid) supralin N

3 pyramidum7 piramidarum F; sicut7 si erit F, sic HK

4 sic7 sicud F, sicut GHK; diameter7 diametri AEGHKL, dyametri J; operaberis7 operare B, operabis J

5 per pyramidellam om GH; si...pyramidellam7 per piramidam vel primaidellam F

6 sperullam7 sperellam BJ; Et...sperullam (speram E) repeated AELN; metiri om F; volueris7 si F, similiter add AEGHJKLN; diametri ad repeated G

est, de maximis circulis utriusque spere loquor, et provenit numerus secundum quem sperula est in spera. Et generaliter sic de similibus corporibus sive sint laterate columpne, sive laterate pyramides, sive conice spere, vel quomodolibet aliter se habentia similia corpora (*239v*).

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1 que eadem est] ad modus est *F*, quod ad idem redit et *GHK*; provenit] proveniet *HL*

provenit] per 15 12' (*Euclid*) *supralin N*

2 quem *om BEK*

3 similibus] consimilibus *J*; sint *om F*; laterate] sive *add F*; sive^2] vel *E*

4 sive] vel *B*; conice] coni *BJK*, conjuncte *G*; spere] protespere *BJ*; vel] et *F*

sive] id est angulares *supralin E*

5 corpora] *155v B*; *38r E*; *42v F*; *39 v^a G*; *88r J*; *25v K*; Explicit *add 16r H*; *292v N*; et cetera cetera. Explicit practica geometrie secundum magistrum Campanum Novariensem. Deo gratias quod R. Enyleon? *add 259v L*

corpora] *mg B*:

versus de circulo inveniendo per dyametrum	si per dyametrum sic circulus inveniendus dyametrum tripla pars septima sic quoque una et ter circuitus mensura patet manifesta
versus de dyametro habendo per circulum	Sed si dyametrum per circuitum sit habenda? parte bis undena de circuitu resecata Dyametrum faciet ter tertia pars remanentis

APPENDIX A

MAIHINGEN II I Q 61: A SEPARATE TRADITION

I have indicated earlier that the *Quadrans vetus* is one of a rather large body of works written between the eleventh and fifteenth centuries that describe various types of quadrants. Some of these documents have similar or identical incipits and are thus hard to identify in the manuscript catalogs. A number of them include material apparently from common sources. Among these, I have found one that must be discussed in a study of *Quadrans vetus*. This treatise, found in a Maihingen manuscript, has the same incipit as *Quadrans vetus*.[1] The first seven sentences of this work are common to the other. These include the definition of geometry and of the three divisions of applied geometry, altimetry, planimetry and steriometry. From this point forward, however, the writer departs from *Quadrans vetus* and begins a series of short discourses on several related instruments and topics. His first is a description of the use of "Jacob's rod" or the cross-staff, an instrument perhaps named for Jacob ben Machir ibn Tibbon (died c. 1304) but first described in Latin by Levi ben Gerson in 1342. The latter was probably its inventor.[2] It is used in the Maihingen manuscript for the measure of heights of objects.

From this the author moves on to the solution of various problems by use of the shadow square, referring to it as the altimetry scale of quadrants and astrolabes. This square for measuring similar triangles by use of tangents and cotangents is a part of the old quadrant. It is described in *Geometrie due sunt partes principales*, one of the two presumed sources of *Quadrans vetus*. Many of the problems presented for the square are parallel to those in the corresponding section of *Quadrans vetus*. Large sections of the latter, in paragraphs 51 through 78, are almost identical to portions of this treatise. The same material appears also in *Geometrie due sunt partes principales*, as has been demonstrated in the section on sources of *Quadrans vetus*. This includes problems of altimetry, planimetry and steriometry. At the end of this section is a summary chart of the measuring of accessible and inaccessible objects and a short discourse on the use of a mirror in the measurement of a plane. This concludes the first part of the treatise.

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[1] Maihingen II I Q 61, fifteenth century, ff. 6v–11v, begins "Geometrie due sunt partes theorica et practica. . .."

[2] Taylor, *The Haven-Finding Art*, p. 129; cf. also Sarton, *History of Science*, III-1, pp. 600–601, p. 851. Sarton states that the instrument may have been named for Jacob but that it was invented by Levi ben Gerson. Taylor simply states that Gerson was the first to produce a Latin description. All dated manuscripts concerning the rod in Thorndike and Kibre, *Catalogue of Incipits*, cols. 17, 25, 34, 173, 506, 1069, 1462 and 1469, are mid-14c or later.

On folio 8v the author begins the second portion, a separate essay on the movement of the sun, moon and the planets. This is apparently preliminary to his discussion of the astrolabe which follows. In the planetary motion treatise, he discusses the use of the bissextal tables and the position of the sun on various days throughout the year. Then, beginning on folio 10r, there is a third discourse which covers the astrolabe. The author first describes the material to be found on both front and back of the instrument and then the use of these materials. The major instructions concern finding the position of the sun and of certain stars and using this information to obtain one's latitude.

This rather short section is followed on folio 11v by a chapter on the quadrant, beginning: "Quadrantis noticiam habere affectantes. . . ." Thorndike and Kibre catalog this as a separate treatise and cite copies in several manuscripts.[3] The work begins with a few instructions for making a quadrant without the cursor or the shadow square. The directions are simple to the point of being inadequate in several matters. They are not nearly as accurate for construction as those found in *Quadrans vetus*. Then there are particulars on deriving the degree of elevation of the sun, needed because of the lack of a cursor. These instructions are given with several examples of feast days. The construction section is followed by a passage on usage, as in *Quadrans vetus* and other treatises on the quadrant. The author begins this section with instructions on telling time by using the degree of the sun and the hour lines on the instrument. The remainder is omitted, however, as the Maihingen treatise ends incompletely at the bottom of folio 11v. Folio 12r begins a set of tables that are not a part of this treatise.

The material missing in the Maihingen manuscript is available elsewhere. A second copy of the last portion, the quadrant treatise, appears in a Munich manuscript, CLM 11067, folios 194v^a–195v^b. This copy continues past the section on telling time and goes on to the measuring of the altitude of an accessible object. This is followed by a discourse on measuring depths, with the example given of the depth of a valley measured from a position on a nearby mountain. Here again the author provides instructions for the solution by use of the shadow square, as though it were standard equipment in his quadrant. There are no directions for construction of this part of the instrument earlier in the treatise, but there is a diagram of a quadrant containing one on the last folio. The shadow square is unusual, in a diamond shape, but the scale is measured properly and this version is as accurate in measurements as any other.

This last portion concludes the general treatise which began "Geometrie due sunt partes theorica et practica. . . ." The document is a short summary of earlier works and was probably intended for a handbook. Precise dating of it is impossible at this time; the two copies available to me are from the fifteenth century, and Thorndike and Kibre list none older than these in their catalog.[4] However, the possibility that this treatise is earlier than *Quadrans vetus* must be considered. The material is presented in a sketchier manner, and some instruments described are certainly older than the old quadrant. The shadow square is the instrument which we noted earlier was known in the late eleventh or early twelfth century. It is described in a thirteenth-century copy of *Geometrie due sunt partes principales.* The quadrant described is one that preceded the old quadrant and has no cursor. Yet, the Jacob's rod was not known in Latin and perhaps not even invented until the work of Levi ben Gerson in 1342.[5] From this last, one may conclude that the Maihingen author was writing a summary article, perhaps in the fifteenth century, on several old but still available instruments. Other evidence for this view is seen in the lack of detail in the construction section on the quadrant and the omission of a construction section for the shadow square. If the author used any of the texts I have studied as his source, it would have to have been *Geometrie due sunt partes principales.* Had he been using *Quadrans vetus,* it seems unlikely that he would have passed over the old quadrant and gone back to an earlier instrument without a cursor. It seems that the only connection between the *Quadrans vetus* and the Maihingen treatise is an indirect one, that they were both derived in part from *Geometrie due sunt partes principales.*

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[3] Thorndike and Kibre, *Catalogue of Incipits*, col. 1156.

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[4] Ibid.

[5] Taylor, *Art.*; cf. also Charles H. Cotter, *A History of Nautical Astronomy* (London, 1968), p. 64, and Sarton, *History of Science.*

APPENDIX B

OXFORD, UNIVERSITY COLLEGE MANUSCRIPT 41 VERSION OF *QUADRANS VETUS*

This version of *Quadrans vetus,* appearing in an early fourteenth-century manuscript, is different enough from the usual text of the treatise to justify its being transcribed separately.[1] There are a number of lengthy additions, substitutions, and omissions. The first major departure from the usual rendition of the text occurs in paragraph 4. This is a twelve-line addition and is typical of the changes throughout the text. For convenience in comparing the two texts, I have kept the same numeration of paragraphs which I used in my edition of *Quadrans vetus.* This has occasionally caused omission of numbers and odd lengths of paragraphs.

One addition to the text provides internal evidence for an English origin of the manuscript. In paragraph 44 the scribe gives the usual latitudes of Montpellier and Paris and then adds those of London, Coventry and Kenilworth. I have seen only one other manuscript of the treatise which includes any additional cities. This one exception, Cambridge, Trinity College 0.5.4, is a fifteenth-century copy which includes the degrees of Coventry with those of Montpellier and Paris.

It should be noted that this copy is incomplete. Throughout the work there are letters which in other copies are included to indicate points on accompanying drawings. There are no drawings in the Oxford copy. Some other manuscripts include such letters without the corresponding illustrations for certain difficult passages, but none use them so frequently without including drawings. Also, the usual chart showing the position of the sun in the zodiac at the beginning of each month is unfinished; space is provided, but the degrees and minutes are omitted.

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[1] Oxford, University College Manuscript 41, ff. 36v–39r.

TEXT

(No title)

1. Geometrie (36v) due sunt partes scilicet theorica et practica. Theorica est que sola mentis speculatione quantitates proportiones et earum mensuras intuetur. Practica est quando alicuius rei ignotam experimento sensibili mensuramus. Mensurationis autem artificialis, que practica dicitur, tres sunt species, scilicet altimetria, planimetria et steriometria. Altimetria est quando solam rei altitudinis longitudinem querimus. Planimetria est quando rei latitudinem querimus. Steriometria est quando longitudinem, latitudinem et profunditatem querimus et investigamus. Primo modo mensuramus linearem dimensionem, secundo superficialem, tertio modo dimensionem corporalem.

2. Tractatum igitur istum, in quo docebimus mensuras omnium rerum cognoscere secundum quod ad introductionem artis pertinet, in duas partes dividimus. Nam in prima parte docemus de quadrantis compositione, dicti a quarta parta circuli quam continet; in secunda de eo quod per ipsum exercetur et de utilitatibus eius.

3. Est igitur quadrans quoddam instrumentum quartam circuli et quasdam linearum protractiones continens, per quod possumus gradum Solis et eius declinationem et stellarum altitudines accipere, horas temporis discernere, rerum altitudines, civitatum distantias, terrarum longitudinem, puteorum profunditatem invenire.

4. Cum quadrantem volueris componere fiat hoc modo: accipiatur tabula enea vel lignea vel auricalcea bene posita. Que reducatur ad formam quarte partis circuli hoc modo cuiuscumque fuerit figure sive scilicet circularis sive angularis. Ponatur pes circini immobilis in aliquo loco tunc quomodo possit scriberi maximus circulus cuius una quarta non excedat quantitatem tabule et sit ille punctus in quo stat pes circini immobilis A et circini ducatur alius pes distribuendo portionem circuli maiore una quarta. Utrum aut fuerit maior vel minor sic leviter postperpendi. Ducatur linea recta ab A usque ad terminum illius portionis secundum illam super C. Et postea ponatur unus pes circini in illa sectione C circino non diversificato et ubi alius pes cadat in predicta portione sic nota D. Deinde divide arcum CD in duo equalia super punctum F. Postea accipies arcum equalem arcui FD in fine cuius sic nota B. Erit ergo arcus CB quarta pars circuli quoniam CD est sexta pars circuli ut post habetur ab Euclide.[2] (ad partem? quartem circuli mg) Vel aliter fiat circulus in alia tabula plana, cuius quarta adequetur quadranti, et illius circuli rectissime accipiatur quarta pars cum circino, et secundum illius quantitatem fiat quadrans, et infra latera quadrantis dimittatur spatium parvum ex omni parte, protrahendo duas lineas rectas per 5 primi Euclidis constituentes angulum omnino rectum et infra

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[2] hoc (*l. 4*). . .Euclide is the first major departure from *Quadrans vetus*.

angulum quadrantis: qui angulus vocetur A ut predictus et fiat secundum hanc artem. (ad habendum spatium de angulis? in lateribus mg)

5. Protrahatur una linea subtilis ab angulo quadrantis B ad angulum C, et dividatur, per 10 primi Euclidis, in duas partes equales, et in puncto medie divisionis ponatur pes circini immobilis, et alius pes extendatur ad aliquem terminum iuxta A, a quo termino vel puncto tu vis protrahere lineas rectas iuxta latera quadrantis, que infra se debent includere quartam partem circuli. Extenso pede mobili circini ad illum rectum, postea secundum illum situm moveatur versus B et C et sic signetur locus in linea subtili iam protracta, ubi pes circini mobilis tangit illam lineam: et a puncto iam dicto iuxta A usque ad punctum contactus iuxta B et C ducantur due linee, et includent infra se superius iuxta angulum dicendum unam quartam partem circuli, protrahendo unam lineam circumferentialem, que contineat quartam partem rectissime unius circuli. Et illa pars inferior quadrantis, ubi est illa linea circumferentialis, vocetur limbus; et ille due alie partes extreme vocentur latera quadrantis. Et super latus quadrantis dextrum due tabule parve erunt equidistantes ab extremitatibus lateris AC; et sint perforate parvis foraminibus equidistantibus linee AC descendenti.

6. Item infra lineam circumferentialem scilicet BC, protrahantur due linee circulares equidistantes inter quas dimittantur aliquantula spatia infra que describi possint in inferiori spatio iuxta limbum singuli gradus et in superiori numerus graduum, ut patebit in figura. Et linea inferior, scilicet CB, dividatur in duas partes equales super punctum E et a puncto divisionis (ad dividendum limbum in gradu 90 mg), usque ad A protrahatur linea recta dividens quadrantem in duas partes equales, et utraque pars linee BC scilicet BE at EC dividatur in 9 partes equales, per 29 tertii Euclidis, ita quod quelibet pars. Postea dividatur in tres, et quelibet illarum partium in alias tres. Et linee divisionum protrahantur a linea circulari inferiori ad lineam circularem superiorem tertiam, occupando duo spatia inter circulos continentia 18 in limbo inferioris circumferentie. Erit itaque limbus in 18 partes equaliter divisus in quarum prima iuxta B ponatur figura Algorismus denotans 5, in secunda 10, in tertia 15, in quarta 20 et sic de ceteris semper addendo 5 usque ad C ubi erunt 90.

7. Deinde quodlibet spatium istorum 18 dividatur in 5 gradus equales, et protrahantur linee divisionum ab inferiori circulari linea ad aliam circularem proportionem sequentem inter iam distantias circulares et ita in tota quarta habebimus quinquies 18 que sunt 90 gradus. Tot

enim gradus debent esse in quarta cuiuslibet circuli. Et istud spatium sic divisum vocamus limbum.

8. Consequenter dimittatur spatium ad quantitatem duorum digitorum et dimidii vel prope illud, et protrahatur linea circularis distinguens spatium inferius a superiori, et vocetur illa linea FG. (37r). Et linea illa dividatur per 29 primi (tertii supralin) Euclid in 6 partes equales et notentur puncta divisionum ita quod cognoscantur, et vocentur H, I, K, L, M, N. Et tunc ponatur quadrans in tabula plana, et taliter figatur cum clavis quod non moveatur de loco de facili.

9. Tunc alia tabula conjungatur ei in equali superficie in puncto C, ita quod ab A possit trahi linea in continuum et directum in illa tabula versus C. Et tunc ponetur unus pes circini in A, et aluis pes extendatur in linea AC extra quadrantem et querendo punctus in linea AC, illa AC extra quadrantem ponatur. In quo posito pede circini immobili pes mobilis existens in puncto A transeat per puncta AH describendo lineam arcualem que vocatur AH que est linea hore prime et hore undecime diei artificialis.

10. Postea queratur punctus in eadem linea AC versus A. In quo posito pede circini immobili alius pes circini transeat per puncta AI ab A in I describendo lineam arcualem AI que est linea hore secunde et 10^{me}. Iterum

queratur in linea AC alius punctus. Et fiat arcus transiens per A et K qui est arcus hore 3^{e} et 9^{ne}. Deinde queratur alius punctus in eadem linea in quo posito pede circini immobili. Mobilis pes describat arcum ab A in L transeuntem qui est arcus 4 hore et 8. Ad huc in eadem linea quere alium punctum et pede circini in illo posito pes alius describat lineam arcualem exeuntem ab A ad M que est linea hore 5 et 7. Ultimo querendus est punctus in illa linea videlicet in medio inter N et A et ibi posito pede circini immobili transeat ab A ad N describendo semicirculum qui dicitur AN et est iste semicirculo deserviens? ad horam 6 que est in meridie. Per istas lineas arcuales modo predicto artificialiter protractas accipientur hore cuiuscumque diei artificialis sive sit maior sive minor scilicet 6 hore ante meridiem at 6 post meridiem ut postea patebit istis lineis horarum sic protractis.

11. Fiat quedem concavitas in illo spatio intercepto inter lineas circulares in limbo et linea superiorem circumscriptam? que vocatur GN, et in illa concavitate situetur quedem tabula plana et bene posita que currat et moveatur in ille concavitate a termino ad terminum. Illa igitur tabula habeat in longitudine 48 gradus in limbo; et si habeat plus, hoc erit de bene esse et vocabitur cursor sive circulus sive labellus.

12. Et dividatur dicta tabula scilicet cursor per 4 partes equales secundum latitudinem cum quibusdam lineis circularibus, et quelibet quarta in 3 partes inequales, et erunt omnes 12.

13. Consequenter longitudo cursoris dividatur in 2 partes equales per lineam rectam protractam per totam longitudinem equedistantem ab extremis. Et sit extremitas cursoris dextra P, et sinistra S. Et linea media vocetur QR; ita quod superius sit Q et inferius R.

14. Tunc sciendum est quod tria spatia inferiora in latitudine cursoris et 3 superiora continebunt duas medietates zodiaci cum signis et gradibus et numero graduum; et sex spatia intermedia continebunt duas medietates anni cum mensibus et diebus et numero dierum; que quidem 2 medietates anni correspondent 2 medietatibus zodiaci. Nam in una medietate anni movetur Sol per unam medietatem zodiaci ascendendo et in alia per aliam descendendo. Et ita istis 2 respondent 6 inferiora spatia et 6 superiora.

15. Consequenter incipiendum est ponere signa in tribus spatiis inferioribus et in tribus superioribus hoc modo, ponatur linea media cursoris scilicet QR super principium alicuius gradus in limbo et computentur 11 gradus et dimidius in limbo versus C, quia tanta est declinatio Solis ab equinoctio si ipso exeunte in fine

Arietis; scilicet 11 gradu et dimidii ponatur ergo regula super 11 gradum et dimidii et super punctum A, et protrahatur una linea recta occupans tria spatia inferiora et tria superiora versus P, et ista spatia repondent duobus signis, inferius Arieti et superius Virgini.

16. Postea a fine 11 graduum et dimidii computentur gradus 8 et dimidius, et ibi et super punctum A ponatur regula sicut prius, et protrahatur linea sicut prius in tribus inferioribus spatiis et in tribus superioribus; et erunt 2 spatia aliorum 2 signorum, scilicet Tauri et Leonis, quoniam illorum eadem erit declinatio.

17. Et tunc in fine cursoris versus P inter lineas iam protractas et illum finem erunt spatia 2 signorum scilicet Geminorum et Cancri.

18. Consequentur fiat divisio alia in alia a linea media cursoris parte versus S, ita scilicet quod primo dimmitatur spatium 11 gradum et dimidii inferius et aliud superius. Et istis 2 spatiis scribantur 2 signa, Pisces inferius et Libra superius.

19. Dimittantur 2 spatium 8 graduum et dimidii, Aquarius inferius et Scorpius superius.

20. Deinde in 2 spatiis in fine versus S, ponantur alia 2 signa remanentia, scilicet Capricornus inferius et Sagittarius superius.

21. Et quodlibet spatium de tribus inferioribus

spatiis et tribus superioribus respondentibus signis dividatur per 30 gradus, ita quod in spatio cuiuslibet signi gradus scribantur inferius et numerus graduum superius, et super numerum graduum nomina signorum; et erunt ergo tria spatia inferiora occupata et tria superiora.

22. Et remanent 6 spatia intermedia in quibus scribantur 12 menses. Hoc modo: videatur in tabula signanti in quo gradu Capricornii incipiat Januarius, et super illum gradum et super punctum A posita regula et protrahatur una linea, tria spatia occupando que sunt supra tria spatia inferiora signorum.

23. Postea videatur in tabula in quo gradu Aquarii incipit Februarius, et super illum gradum et super punctum A posita regule; protrahatur alia linea occupando ista 3 spatia eadem. Et in spatio intercepto (37v) inter illas duas lineas protractas per illa tria spatia scribatur Januarius in superiori spatio illorum trium, sed in inferiori ponantur dies mensis Januarii et in spatio medio numerus dierum.

24. Consequenter videatur in tabula in quo gradu Piscium incipit Marcius, et super illum gradum et punctum A posita regula, et protrahatur linea per 3 spatia ut prius, et erit spatium in quo scribetur Februarius, qui solus 28 dies habet, cum diebus suis et numero dierum.[3]

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[3] Paragraphs 24, 25 and 26 in this version are respectively numbered 25, 26, and 24 in the usual edition of the text.

25. Postea videatur in quo gradu Arietis incipit Aprilis, et protrahatur linea ut prius et scribatur Aprilis cum diebus et numero dierum. Et ita fiet de omnibus mensibus anni. Ars autem scribendi dies mensium in suis spatiis hoc est.

26. Videndum est si mensis habeat 30 dies; tunc dividatur in 6 partes equales, et quodlibet partium contineat 5 dies, et erunt 30. Si vero mensis contineat 31 dies, tunc primo dimittatur spatium unius diei secundum estimationem propinquam veritati, et residuum spatium dividatur in 6 spatia, et quodlibet illorum 6 in 5, sicut prius. Februarius vero qui solum 28 dies habet dividatur post in 4 spatia equalia quorum quodlibet continet 7 dies.

27. Et sciendum quod December et Junius debent scribi ita quod una medietas illorum scribatur inferius in medietate inferiori et alia medietas in medietate superiori, ad significandum quod in duabus medietatibus ascendit Sol in zodiaco et in reliquis duabus descendit. Et sicut scribuntur menses cum suis diebus et numeri dierum in parte inferiori cursoris, ita scribantur in superiori.

28. Et si quadrans est magne quantitatis, tot erunt spatia sub mensibus quod sunt dies in mense. Ita quod linee continentes quinos dies vel 6 vel 7 vel 10 protrahantur occupando due spatia, ut facilius computentur numeri dierum et scribantur. Et linee distinguentes dies

non occupent nisi unum spatium. Si quadrans fuerit parve quantitatis, ponatur spatium pro 2 diebus vel 3, secundum possibilitatem quadrantis. Et hec de cursore dicta sufficiant.

29. Hec presens tabula docet in quo loco sit Sol in iniciis mensium.

Inicia dierum mensium	Signi	Grad.	Min.
Inicium primi diei Marcii	Pisces		
Inicium primi diei Aprilis	Aries		
Inicium primi diei Maii	Taurus		
Inicium primi diei Junii	Gemini		
Inicium primi diei Julii	Cancer		
Inicium primi diei Augusti	Leo		
Inicium primi diei Septembris	Virgo		
Inicium primi diei Octobris	Libra		
Inicium primi diei Novembris	Scorpius		
Inicium primi diei Decembris	Arcitenens		
Inicium primi diei Januarii	Capricornus		
Inicium primi diei Februarii	Aquarius[4]		

30. Consequenter fiat scala altimetra sic; linea AK, que est ab A usque ad cursorem, si quadrans cursorem habeat, vel ab A usque ad K, si non habeat cursorem, dividatur in 2 partes. Et in puncto medie divisionis ponatur pes circini immobilis, et alius pes extendatur usque ad punctum in angulo iuxta A; et tunc ille pes

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[4] Degrees and minutes are omitted in the chart but space is provided.

mobilis motu suo signet duo puncta intersecando lineis descendentes iuxta latera quadrantis et a puncto K, si est cursor, vel a conjunctione linee medie cum superiori circumferentiali linea limbi, protrahantur due linee recte, et alie 2 supra utrumque illarum eis equidistantes occupantes 2 spatia.

31. Et hec linea dividatur in 12 partes equales hinc inde, et protrahantur linee illas divisiones distinguentes et scribuntur. Ita supra quod una linea secet minus spatium terminum et alia et minus et maius spatium. Et in maiori spatio scribatur numerus punctorum. Ita quod primo inter lineam AC scribatur binarius et consequenter quaturtiarius (stet) et ita usque ad 12 semper augendo per 2. Et super iuxta lineam AB scribatur 2 et consequenter 4 ut prius. Quadrato descripto quod dicitur scala altimetria fiat clavus subtilis detentus compositus habens capud rotundum et bene factum et figatur in cono quadrantis scilicet in puncto A per quem suspendatur filum de serico subtile habens in eius extremitate inferiori perpendiculum de plumbo vel de aliqua re ponderosa et illa linea dicitur perpendicularis super quam sit margarita perforata vel nodus factus de alio filo vel pilo ita quod possit amoveri de loco ad locum sursum et deorsum super filum prefatum. Duo vero dentuli (vel tabule supralin) componendi iuxta AC qui erunt perforati ita scilicet quod unum foramen tantum

distet alia AC quantum et reliquum. Et erit completa compositio quadrantis.

32. Dicto de compositione quadrantis, dicendum est de utilitatibus et operationibus, que habentur per eum.

33. Si igitur velis scire altitudinem Solis in omni hora per quadrantem, pone punctum A quadrantis versus Solem et punctum C versus te, et fac radium Solis transire per ambo foramina duarum tabularum perforatarum quem (stet) dicitur dentuli (stet). Et vide quem gradum ex gradibus limbi abscindat perpendiculum, et respice numerum graduum superius scriptum qui ostendet tibi altitudinem Solis in eadem hora. Si autem de nocte altitudinem alicui stelle volueris invenire videas illam per utraque foramina et perpendiculare ostendet altitudinem illius stelle.

34. Si velis scire in quoto gradu signi sit Sol per cursorem, respice in quoto mense es et in quoto die mensis, et pone perpendiculum super illus diem in cursore, et nota super quod signum sub illo mense et super quem gradum illius signi cadit filum, quia in illo gradu eiusdem signi erit Sol.[5]

39. Si autem velis scire declinationem Solis id est distantia eius ab equinoctiali per cursorem, pone filum super principium Arietis et Libre, et nota gradum ubi cadat filum in limbo. Deinde pone filum super gradum in quo est Sol secundum artem iam dictam et nota gradum in limbo

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[5] This version does not contain the material which appears in paragraphs 35–38 of *Quadrans vetus*. However, the numeration of *Quadrans vetus* will continue in this text for convenience.

super quem cadit filum et computa tot gradus in limbo inter primum gradum et ultimum iam acceptum, et tanta erit declinatio Solis.

40. Ista tamen duo secundum gradus Solis et eiusdem declinationem inveniuntur per tabulas quasdem ad hoc constitutas.

41. Si vis scire latitudinem regionis id est distantiam cenith ab equinoctiali sive altitudinem poli, quod item est, altitudinem Solis accipies in meridie ipso existente in principio Arietis vel Libre. Et illam altitudinem subtrahe de 90 gradibus, et residuum erit latitudo regionis sive altitudo poli.

42. Vel sic: Accipe altitudinem Solis in meridie quacumque die volueris, et de ipsa subtrahe eiusdem declinationem in die, si Sol est in signis septemtrionalibus, vel adde si sit in signis meridionalibus, et quod post subtractionem vel additionem remanserit subtrahe de 90 ut prius, et habes latitudinem regionis vel altitudinem poli. Et nota quod signa septemtrionalia sunt hec Aries, Taurus, Gemini, Cancer, Leo, Virgo. Signa vero meridionalia sunt Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces.

43. Vel aliter ad idem: Accipe altitudinem alicuius stelle fixe notabilis iuxta polum cum fuerit in maiori sua altitudine de nocte. Item accipe altitudinem eiusdem

stelle cum fuerit in minori sua altitudine in eadem nocte vel alia; et minor altitudo subtrahatur de maiori et medietas differentie addatur altitudini minori vel subtrahatur de maiori, et quod inde provenit est altitudo poli sive latitudo regionis.

44. Si autem vis scire horas diei inequales in omni diei dispositione cursoris secundum situm regionis in quo est hoc modo, vide altitudinem regionis sive altitudinem poli, secundum aliquam iam dictorum modorum sit artificiose inventam, que est in Montepessulano 44 graduum 44 minutarum fere et Parisius 49 graduum 32 minutarum, London 51 graduum 40 minutarum, Coventri et Kenilleworth 52 graduum et 20 minutarum. Et computa tot gradus secundum quot fuerint in altitudine poli illius civitatis in qua horas diei inequales scire desideras in limbo quadrantis a latere dextro versus sinistrum. Et ubi numerus ille terminabitur move cursorem donec principium Arietis et Libre scilicet equinoctialis linea cadat sub ipso perpendiculo directe, et talis situs cursoris erit in regione illa perpetuus.[6]

46. Cum igitur ille cursor fuerit sic dispositus, pone perpendiculum super diem cuius horam vis habere, et trahe margaritam donec cadat super lineam circumferentialem ultimam que est finis 6^e hore; post hoc dimitte radium Solis transire per ambo foramina, et nota locum margarite in horis, quoniam ipsa ostendit horam diei in qua es et

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[6] Material in paragraph 45 of *Quadrans vetus* is not included in this text.

partem hore. Si enim cadat super lineam primam arcualem, finis hore prime; si supra secundam, erit finis hore secunde, et sic de ceteris. Si autem margarita acciderit super partem alicuius hore et volueris scire quarta pars totius hore fuerit vide tactum perpendicularis in limbo quem notabis et etiam principium atque finem in eodem notabis quod quarta pars graduum totius hore fuerint gradus intercepti inter principium hore eiusdem et tactum perpendicularis tota pars hore est transacta.

47. Si vero horas per quadrantem sine cursore velis habere, accipe in quatuor tabulis quadrantis gradum Solis, et cum eo in tabula declinationis accipe eius declinationem, quam subtrahe a latitudine regionis in qua es, si Sol fuerit in signis septemtrionalibus, vel adde, si fuerit Sol in signis meridionalibus; et quod fuerit post subtractionem vel additionem residuum, tene, et tot gradus computa in limbo a latere quadrantis dextro scilicet super quod infixe sunt parve tabula perforate; et pone perpendiculum ubi terminatur numerus, et move margaritam usque ad lineam meridionalem, et ille erit situs margarite ad talem diem; tunc dimitte radium Solis transire per utraque foramina, et nota locum ubi cadit margarita, et habebis horam sicut prius. Si autem fueris in latitudine nota a qua ad ignotam exire volueris in qua nescis dispositionem cursoris, regula est ut videas semper quot

miliaria sint inter illas duas latitudines quia quotiens habueris 56 miliaria et 2 tertias unius totiens per gradum unum move caput Arietis et Libre a latitudine nota versus B si jecis contra septemtrionam vel versus C si jecis contra meridiem. Dispositionem cursoris sicut horas diei poteris invenire, pone perpendicularem super diem mensuratam in quo fueris et subleva vel deprime parum margaritam donec fiet super circularem lineam de numero linearum 6 horarum et sic disponitur recte quadrans et cetera.

48. Consequenter dicendum est de mensurationibus et primo de mensuratione rerum altitudinum.

49. Si vis igitur scire altitudinem alicuius rei accessibilis, respice summitatem rei per ambo foramina uno oculo, et accede ad rem vel recede a re in tantum donec perpendiculum cadat super lineam mediam quadrantis id est super 45 gradum limbi. Deinde mensura quot sunt pedes inter notam et fundamentum turris vel basim altitudinis rei mensurande et ad illos adde staturam tuam ab oculo usque ad plantam pedum, et habebis altitudinem eius.

50. Si vero res non est in loco plano, respice aliquod punctum in re mensuranda, perpendiculo cadente super lineam AB que est in sinistro latere quadrantis, et nota punctum. Et tunc non accipias altitudinem

stature tue que est ab oculo tuo usque ad terram, sed altitudo puncti notati a terra; tunc quantum est inter pedem tuum et rem mensurandam, tanta est altitudo a puncto notato superius computando; adde tunc illi altitudini altitudinem puncti a terra, et habebis quesitum.

51. Vel sic: Respice altitudinem rei in summitate sua per utraque foramina et vide quem locum quadrantis tetigerit perpendiculum, et si ceciderit super latus umbre recte scilicet in dextro latere quadrantis, respiciendo super quotum punctum cadat perpendiculum. Si autem ceciderit super latus umbre verse, per numerum ipsorum punctorum umbre verse divide 144, et exibunt in numero denominato quotiens puncta umbre recte. Numerum igitur punctorum umbre recte sume prius hoc.

52. Spatium inter te et basim rei multiplica per 12, et productum divide per puncta umbre recte prius sumpte, et super illud quod exierit adde altitudinem stature tue a pedibus usque ad oculos et hec erit altitudo rei quesite.

53. Hoc idem fit, Sole lucente, per umbras sic: Expecta donec Sol fuerit in altitudine 45 graduum; tunc umbra cuiuslibet rei est equalis rei; mensura tunc umbram et habebis altitudinem rei. In aliis autem horis erit proportio umbre ad rem sicut in eadem hora est proportio numeri punctorum umbre recte ad 12: ut si fuerint 6 puncta umbra recta, que sunt medietas de 12,

erit tunc umbra medietas rei altitudinis: et sic de aliis.

54. Sed ad hoc quod omni hora habeas puncta umbre recte oportet te scire mutare umbram versam in rectam et e contrario quod dictum fit. Per puncta unius umbre habita divide 144 et exibunt puncta alterius umbre ut si 8 puncta umbre verse habueris et scire volueris puncta umbre recte divide per 8 .144. et exibit numerus quotiens 18 et hec sunt puncta umbre recte. Similiter potest fieri e converso.[7]

57. Si autem turris fuerit inaccessibilis mensuranda, vide summitatem eius que sit A per ambo foramina quadrantis, et respice numerum punctorum umbre recte ut prius, et pone signum D in loco quo stetisti et sit D.

58. Consequenter elonga te a turri vel propinqua ei secundum lineam rectam, et vide iterum altitudinem turris, et numerum punctorum umbre recte ad hunc statum secundum, et pone aliud signum scilicet E in illo loco. Deinde mensura quot sunt pedes inter duos status scilicet E et D; post hec subtrahe numerum minorem punctorum umbre recte unius status (?) punctorum alterius status minorem de maiori et quod remanserit erit differentia punctorum. Deinde mensuram inter dicta duo loca multiplica per 12 et productum divide per differentiam punctorum prius sumptam, et ei quod exierit altitudinem stature duc usque ad oculos et hec erit

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[7] Material parallel to para. 55–56 of *Quadrans vetus* is summarized in para. 54 of this text; thus there are no paragraphs 55–56 in this version.

altitudo turris, quod sic se habet differentia punctorum .2. statuum ad .12. sic distantia statuum ad altitudinem rei. Quod si altitudinem turris in monte sito metire vis considera primo altitudinem montis per .2. stationes per modum predictum. Deinde altitudinem montis et turris scilicet adde per eandem doctrinam et remove altitudinem montis de toto et remanebit altitudo turris.[8]

60. Si autem non habeas quadrantem et velis mensurare altitudinem AB, accipe virgam DE et erigatur super planum perpendiculariter BC: et habeat virga notam quantitatem; pone itaque oculum tuum iuxta terram, movendo caput huc et illuc, donec radius visibilis transeat per summitatem virge et per superiorem partem altitudinem turris.

61. Deinde considera distantiam que est inter locum super quem est oculus tuus scilicet C in hora considerationis, et inter inferiorem partem rei B, et istam distantiam CB multiplica per altitudinem et quantitatem altitudinis virge scilicet DE, et totum illud productum divide per distantiam inter oculum C et virgam D, et exibit in numero denotante quotiens quantitas altitudinis rei scilicet AB ad quod est figura.

62. Item aliter ad idem post haberi per umbram secundo erigatur virga aliqua perpendiculariter super planum prope finem umbre cuius vis altitudinem mensurare et nota locum in virga ubi tangitur ab umbra et per

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[8] Material which parallels para. 59 is not included in this version.

quantitatem virge ab ipso contactu usque ad terram multiplica conum umbre usque ad basim rei mensurande et productum divide per spatium plani quod et inter virgam et terminum umbre et exibit altitudo rei mensurande quod patet in eadem figura.

63. Item aliter sic: Posito speculo E in plano BC inter te et rem mensurandam accede ad speculum vel recede donec in speculo videas summitatem altitudinis scilicet A. Deinde per altitudinem tuam a plano C usque ad oculum F multiplica distantiam que est inter speculum et basim altitudinis mensurande B et divide productum per spatium contentum in plano inter te scilicet per EC et exibit altitudo rei cuius rei exemplar hoc est.[9]

65. Cum volueris mensurare longitudinem plani cum quadrante, sta in uno termino plani, et respice alterum terminum plani per ambo foramina, tenendo conum quadrantis A, ubi est clavus cui filum annectitur, iuxta oculum, et conum C per quem intrat tabula cursoris versus planum mensurandum. Tunc perspecto termino plani accipiatur numerus punctorum umbre recte, multiplica ergo quantitatem altitudinis tue a pede usque ad oculum per 12. Et productum divide per numerum punctorum umbre recte et exibit quantitas longitudinis plani.

66. Vel sic sine quadrante: erigatur una virga AB perpendiculariter in uno termino plani BC, et virge

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[9] Material parallel to para. 64 is not included in this version.

AB insistat alia virga FD equidistanter plano, constituens cum virga AB angulum rectum.

67. Postea iuxta virgam erectam ponatur oculus, et respiciatur alter terminus plani mensurandi, et notetur locus in virga insistente FD per quem transit terminus visualis, et sit iste punctus D; deinde per quantitatem FD multiplica quantitatem AB et productum divide per quantitatem AF et exibit longitudo plani quesita ut patet in figura.

68. Hoc idem est per speculum sic. Ponatur in uno termino plani virga perpendiculariter erecta scilicet BC in qua ponatur speculum erectum super unum latus eius et sic C et tu DE stabis inter (39r) speculum et terminum plani mensurandi qui sit A ubi videlicet capud tuum non impediat videri. Deinde per quantitatem spatii BD inter te scilicet et virgam multiplica longitudinem virge BC ... (one line erased) ... quod sit virga GC productum ex dicta multiplicatione divide et exibit longitudo totius plani BA ubi patet.

69. Si autem vis mensurare planum in longum et in latum, tunc planum aut erit circulare, aut triangulare vel alterius forme. Si sit circulare tunc medietas AB dyametri ducatur in medietatem totius circumferentie BCDA, et productum dabit aream.

70. Quantitas vero circumferentie habetur sic:

tripletur (*stet*) diameter et addatur ei septima pars diametri, et productum dabit quantitatem aree multiplica BC per GE sive per BD quod id est 20 per 24 fuerit 480....[10]

71. Si autem superficies fuerit triangula, tunc si fuerit equilatera, mensuretur sic: dividatur unum latus superficiei triangule scilicet AB in duas equales, et a puncto divisionis D ad angulum oppositum ducatur linea recta CD, et eadem ducatur in unam partem lateris divisi scilicet ABD, et habebitur quantitas trianguli.

72. Si autem triangulus sit duorum laterum AC et BC equalium, tunc inequale scilicet AB, dividatur illud in duo equalia apud D, et a puncto D protrahatur linea ad angulum C oppositum, et una medietas AB linee divise ducatur in lineam protratam ab angulo C ad punctum divisionis D, dabit aream ubi patet in figura.

73. Si autem fuerit trium laterum inequalium, tunc ab angulo C ad latus AB oppositum trahatur linea perpendicularis CD, et illud latus AB super quod stat CD linea cadit perpendicularis ducatur in illam lineam perpendicularem CD et producti medietas dabit aream eius ut hic.

74. Si autem superficiem quadratam vis metiri, duc unum latus scilicet AB in alterum scilicet BC, et productum dabit tibi aream quadrati.

75. Quod si quadranguli vis superficiem mensurare,

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[10] Two and one-third lines of text are erased.

ducatur minus latus AB in maius latus BC, et productum dabit aream eius ut patet in exemplo.

76. Quod si superficiei pentagone vis aream habere, si sit equalium laterum, tunc unum latus AB in seipsum ducatur, et productum ternario multiplicetur; et a summa exeunte subtrahatur quantitas unius lateris semel, et medietas residui erit area.

77. Sequitur de mensuratione profundorum corporum.

78. Si vis putei profunditatem metiri, ab uno latere EK putei respice cum quadrante terminum B oppositi lateris in fundo putei, et notetur quantitas diametri DC latitudinis putei. Accipiatur igitur hora considerationis numerus punctorum umbre in latere quadrantis, et multiplica quantitatem diametri AC latitudinis putei per 12, et productum divide per numerum punctorum umbre, et exibit CB profunditas putei ut patet.

79. Si vero putei capacitatem vis habere, per aream putei, primo invenias ut supra docuimus, multiplicetur putei profunditas, et productum dabit putei capacitatem.

80. Si vero columpne grossiciem vis investigare, sumatur quantitas latitudinis et ducatur in se et habebis aream, per quam aream multiplicetur latus columpne, et habebis eius grossiciem ex producto.

81. Si autem alicuius modii rotundi vis perscrutari capacitatem, sumatur diameter fundi CD modii et diameter

superior AB, et equetur diameter medietate excessus maioris addita minori.

82. Et per diametrum inveniatur area fundi sic in circulo dictum est et per aream illam multiplicetur altitudo modii et productum dabit quantitatem capacitatis modii.

83. Quod si habueris aliquam aliam mensuram parvam tenens mensuram vini vel bladi unius denarius vel duorum, divide numerum quantitatis modii per quantitatem mensure parve, et denominatio exiens ostendet quotiens minus continetur in maiori vel modio; et ita si parvum vas fuerit unius denarii, scietur quot denariate vini sunt in modio.

84. Si autem alicuius dolii capacitatem vis habere, primo invenias aream fundi dolii per eius diametrum, ut dictum est prius. Deinde sume longitudinem dolii secundum vini capacitatem, et per illam longitudinem multiplicetur area, et productum dabit quantitatem dolii.

85. Quod si habueris modium, sume eius quantitatem per predictam, et quantitas dolii dividatur per quantitatem modii; et numerus quotiens ostendet quotiens modius continetur in dolio.

86. Quod si modius fuerit unius nummate vini, scietur quot denariate vini erunt in dolio.

87. Si autem quadranguli vasis capacitatem vis

habere, sumatur area fundi vasis secundum artem supradictam, que area multiplicetur per vasis altitudinem et productum dabit capacitatem. Explicit (39r).

APPENDIX C

LIST OF KNOWN MANUSCRIPTS OF *QUADRANS VETUS* AND *GEOMETRIE DUE SUNT PARTES PRINCIPALES*

The following lists contain references to all known manuscript copies of each treatise. The lists are organized by centuries. Those manuscripts used in the collations of the texts are indicated by the addition in parentheses of the siglum each has been assigned.

PART I: *QUADRANS VETUS*

Thirteenth century

Boncompagni, Baldassare, 323, ff. 4–9, location unknown.
Bruges, Bibliothèque publique de la Ville de Bruges, 528, ff. 25r–32v (B).
Cambridge, University Library, Ii.III.3, ff. 56r–60r (A).
Cambridge, Fitzwilliam Museum, McClean 166, ff. 3r–8v (E).
Copenhagen, Bibliotheca regia Hafniensis, Ny Kgl. S. 275a, ff. 64r–72v (C).
Darmstadt, Hessische Landes- und Hochschulbibliothek, 2661, ff. 135r–143r (D).
London, British Library
  Harley 3647, ff. 55r^{a}–60r^{b} (H).
  Royal 12 C IX, ff. 23r–28v (l).
Milan, Bibliotheca Ambrosiana, H 75 sup., ff. 52r–56v (F).
Munich, Bayerische Staats-Bibliothek, 353, ff. 33v–38r (L).
Paris, Bibliothèque Nationale, fonds latin, 14070, ff. 76r^{b}–80r^{b} (J).
Paris, Bibliothèque Ste. Geneviève, 1043, ff. 43r–48v (G).
Princeton, University Library, Robert Garrett 99, ff. 162v–168v (K).

Fourteenth century

Assisi, Biblioteca del convento di S. Francesco, 174, ff. 101r^{a}–105r^{a} (w).
Bamberg, Staatliche Bibliothek, Math. 1(HJ.V.1), ff. 43r–53r (I).
Berlin, Staatsbibliothek, latin F 629, ff. 19r–20r.
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